JOURNAL OF GAS LIGHTING, WATER SUPPLY, &c.

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EDITORIAL NOTES—GAS, &c.

The Meaning of the City Lighting Contract.

THE new plans for the lighting of the City streets have been ratified by the Court of Common Council; and so we have at length reached a settlement, for a period of ten years, of a matter that has taken nearly that time to bring to this point. The City has grown famous for the violent awakenings, and close wrestlings, that there have been, mainly on the initiative of the Gaslight and Coke Company, in connection with the public lighting; but there is nothing to be gained now by irritating old electrical sores. The whole matter is to-day signed and sealed; and there it has to rest to see what the next decade will bring forth. In effect, there has been a compromise. Gas and Electricity Companies see that, at the low prices to which competition has brought street illumination, if there is to be anything tangible left in it for them, there is nothing to be gained, but much lost, in future, by carrying the competition to further lengths. What, to all intents and purposes, has happened in the City is a compact between the Gaslight and Coke Company and the City Electric Supply Company, whereby the latter will practically retain all the main thoroughfare lighting which they have at present but using centrally suspended high-power flame arc lamps; while the Gas Company will have a hundred or so high-pressure gas-lamps in use, and will light the remainder of the streets—a feature of the scheme being central suspension, brackets, and very few standards.

The City itself will be vast gainers by the scheme, both in money and illumination. The Gas Company are going to light 45½ miles of streets for £6719 per annum, against their old price of £10,099; while the Electric Supply Company are going to light only 10½ miles of streets for £7322 per annum, as against their old figure of £10,774. These figures are significant. For less than one-fourth of the mileage, the Electric Company are going to be paid about £600 more per annum than the total sum to be received by the Gas Company. The figures show that there will be a saving on the gas contract of £3380 through the adoption of the more economical inverted gas-burners, while £3452 will be saved by the reduction of the extravagant charge for the archaic electric lamps in the City to a more moderate one for high-power flame arcs. In addition to this money-saving, the aggregate illuminating power spread over the City streets will be nearly doubled. But this will be chiefly in the arterial streets lighted by high-power lamps—gas and electric. As a matter of fact, the estimated total illuminating power to be given by the Electric Company is 890,400 candles, for only about £600 more than the Gas Company are going to be paid for 377,760-candle power. But the conditions are not relative—large flame arc units against the considerable number of small low-pressure gas units that the Gas Company will have to use to light up (with all costs included) 45½ miles of roadway, against 10½ miles in the case of the Electric Supply Company. No professional electrician, we should imagine, would be so foolish as to try to make capital out of conditions that are so widely separated as a charge of (say) £147 per mile per annum for gas lighting mostly in small units scattered through many miles of streets and £697 per mile for electric lighting concentrated by large units through a comparatively small number of miles of streets—a difference of £550 per mile.

However, neither of the rivals can make any particular commercial point out of the settlement of this contract. It is an agreed settlement; and the Companies have latterly been working, and are working, hand in hand in the matter—to, so far as economy and illumination value are concerned, the large benefit of the City. Mr. Josiah Gunton, the Chairman of the Streets Committee, and his colleagues have been watching sedulously over the interests of the City; and their attitude has enabled the present pacific ending to the long drawn-out contest. It was not for the Committee to consent to the squandering of money in an unnecessary amount of illumination in the side streets, though if the candle powers named for the flame arc lamps are actual and not merely nominal, the contrast between the lighting of certain of the main thoroughfares and the side streets will be strongly marked. In less than one-fourth part of the total mileage of the City streets, electricity will have an illumination representation against which gas will suffer by comparison. But the cost difference and the other conditions per mile referred to in this article must be remembered, and to the advantage of gas. In a special article elsewhere (p. 679) and in a tabulated statement (pp. 680-2), full details of the new scheme are presented.

Municipal Gas Profits—The Coming Battle.

NEXT session of Parliament will see the question of gas-profit appropriation in aid of the rates hotly fought out in the Committee rooms. The Corporation of Eccles and the District Councils of Swinton, Pendlebury, and Worsley have made a move that affords the Corporation of Salford no means of escape from facing both fight and result. They cannot evade the issue, as they did in 1909, by merely withdrawing their Bill, because the outside authorities (as mentioned last week) are also promoting one, which will give Salford the powers they require, and will, if passed, confer on the outside authorities the justice, in this matter of the appropriation of gas profits, which the House of Lords said was their due in the year named.

With us, no personal or local considerations affect the matter at all. It is all a question of principle; and we want to see the principle firmly established—as Parliament has shown an inclination to establish it in the cases of Salford, Oldham, Glasgow, Kirkcaldy, and Stoke-on-Trent (the Potteries Federation Scheme), and voluntarily on the part of the Corporation of Bury—that the consumers of gas are not to have their pockets rifled in the name of the rates through the appropriation of an unlimited amount of gas profits. We should prefer to see profit appropriation for purposes outside that of gas supply abrogated altogether; but anyway the case for limitation is very strong, when one considers how year after year in some cities and towns the gas consumers have been fleeced, without restraint, to the advantage of all ratepayers who are not gas consumers—the greatest beneficiaries of all being the large users of municipal electricity, who, in all probability, have made no contribution whatever to the rates, or very little, through either the "profits" on gas or electricity. There is no adequate defence to the profit-appropriation system; there is no equity about it to-day. The gas consumers pay sinking fund, interest, maintenance, and rates and taxes; and they supply, too, very largely the money required for works' extensions. We are hoping to see further progress in the adjustment of these things in the coming year.

The Salford Corporation do not like the aspect of affairs; and on Thursday last they took counsel in London with a number of representatives of other municipal bodies. Municipal gas owning authorities who have been dipping deeply into the gas profits for years are genuinely alarmed over the outlook. They recognize that this Salford fight means much to them, in the mending of their financial ways, if victory rests with the outside authorities. Significant, too, of this is that present at the conference were two of the most prominent leaders at the Parliamentary Bar—Mr. Balfour Browne, K.C., and the Hon. J. D. Fitzgerald, K.C.; so that altogether it looks as though profit appropriation—the old grossly abused privilege—is going to have one of the strongest defending forces procurable. The representatives of the Corporations who were at the conference promised Salford to support them—whether financially or only otherwise has not transpired. We did not learn that representatives of Manchester were among the number. The "support" of Manchester would hardly assist the cause of profit

appropriation, or legalized freedom in pillaging gas consumers for purposes altogether foreign to gas supply, seeing that both the Gas and Electricity Committees of the Corporation are pledged to the policy of the limitation of profit-transfer to the rates, though they have not yet succeeded in getting the City Council to come round to their way of thinking. However, there can be no doubt we are at length in for a stiff fight over this question; and the matter is in a position to be carried to a definite issue. Salford cannot beat a retreat as things now stand; and the outside authorities who are their opponents have not been able to obtain the satisfaction they require through long negotiation, and they have at their backs the strong verdict of 1909, supplemented by what has since transpired in Parliament.

Personal Efficiency and High Makes.

The paper that Mr. E. G. Stewart read before the Southern Junior Gas Association on "Carbonizing, with Special "Reference to High Makes" (published, with the discussion, in last week's issue) is deserving of further reference, if only to acknowledge the excellent work put into the communication. It was a good bird's-eye view of the current carbonizing position, with here and there a loophole for attack where the author's experience somewhat diverges from that of other men. A busy reader skimming lightly over the paper must take care that he does not place Mr. Stewart in the false light of being in any way antagonistic to "high makes," which is an expression that is loosely used by many, and has not yet been adequately defined by anyone. What was entitled to the designation of a "high" make in past times is not even "good" to-day; and we come down to the "high" makes of very close times to get what have now only the lower distinction of "good" conferred on them. Mr. A. F. Browne in the discussion spoke of 12,850 cubic feet per ton of coal being, in his opinion, only "good." So it must be taken that a "high" make must be somewhere in the region of the 14,300 cubic feet of rather above 15-candle gas from a Yorkshire coal such as one sees attributed to a vertical retort system. Mr. Stewart does not deal with the subject from the economic point of view, but entirely from that of manufacture and the provision of a fairly constant gas in point of composition. In the strain after, and admiration for, high productions, there is indeed a decided tendency, despite frequent cautioning, to take the make results of different undertakings as the hall-mark of manufacturing efficiency. The warning is repeated in the paper, and also by Mr. Browne.

No one has any right to judge personal or works efficiency by make, without being fully informed as to the circumstances. We know a case where a gas engineer was able to purchase a local slack, and get it delivered into his retort-house for a very modest figure; but he could only get from it about 8500 cubic feet of gas per ton with horizontal working. This fact pointed to his efficiency as a gas engineer and manager—the balance of profit per ton being larger than it would have been had he purchased coal from a distance at a much greater expense delivered. Coal supply, plant available, the needs of the markets for residuals, and the prescriptions of Acts of Parliament, are all factors for consideration in relation to high makes; and, unless they are considered, an injustice may be done. But, of course, under the limitations of the conditions of working, all makes should be "good" or "high;" and if they are not, then the question of personal efficiency does come in. Surveying the land in connection with this carbonizing question, there are works to be found where excellent gas-producing coal is being used, but where the retort-benches are of an order that should be promptly scrapped. We are afraid, there is much to be learned by some gas administrators as to when plant and method scrapping is an economy. But it does not follow that, because the time has long since passed when carbonizing plant should be superseded in the cause of true economy, the fault for this should be laid at the door of the gas engineer or manager. He may have had many bitter tussles in the Board or Committee room over the matter, without avail. Therefore, from many points of view, judgment as to efficiency must not fall solely on high makes—the local circumstances may each and all show cause against. At the same time, high makes, qualified by the local circumstances, have been proved, by the weighty test of financial result, to be in the true interests of gas undertakings and consumers alike.

Mr. Stewart looks with suspicion upon the quality of some of the high makes that have been put forward. There is little doubt that there have been examples that would not bear any close chemical analysis without showing certain defects. But that a high make and a good gas—good in calorific power, and containing low percentages of nitrogen and carbon dioxide—are not hostile conditions in practice is an experience that is too substantial now to be impugned. In the tabulated typical figures that Mr. Stewart gives in his paper, it is seen that, with the low-temperature carbonization described, the net calories per cubic foot, with a make of 10,500 cubic feet per ton, are higher than with carbonization at a greater temperature—coal and all of the conditions being equal—when 12,850 cubic feet per ton was obtained. But the total calories per ton of coal carbonized for sale is considerably more in the latter case than in the former. We have seen, using high temperatures, how good is the B.Th.U. value in vertical retort working per cubic foot of gas and per ton of coal. To derive in gas high calorific value per ton is working in the right direction. Mr. T. S. Lacey, in the discussion, put it that the number of B.Th.U. that can be supplied at any given price is the primary consideration of the best value for money in town's gas. Moreover, consulting again Mr. Stewart's table, it is observed that the nitrogen is a fraction less in the case of the high temperature carbonization than the lower. Later on, too, he indicates the infinitesimal calorific power deterioration of the coke produced by the difference in carbonizing temperatures of 1400° and 1800° Fahr. From all production points of view, the argument certainly is heavily in favour of the high make, under normal conditions.

There are signs of the time approaching when managers will think more than hitherto of supplying gas that is of approximately constant composition and density and purity, and at a uniform pressure at the governed service-pipe to the consumer's premises—in fact, there was talk at the Southern Junior Association meeting as to maintaining a "standard" gas. It is the ideal, which has yet to come. There is one thing bearing on the question of purity that was not discussed. Mr. Stewart seems rather favourably inclined to a single ascension-pipe though high heats are used. "If one "ascension-pipe will do the work without trouble," he remarks, "I prefer it; but if not, two are better." Mr. J. Ferguson Bell, Mr. J. W. Morrison, and Mr. J. W. Helps were all recently testifying to the fact that the single ascension-pipe was responsible for an increase in the number of grains of carbon disulphide in gas, contrasted with the gas produced under comparable conditions in retorts fitted with ascension-pipes at both ends. It is an interesting point; and if in the cause of purity with the employment of high temperatures, two ascension-pipes per retort are better than one, then, if the structural conditions will allow of two, two there should be. It is conceivable that the removal of the extra carbon disulphide traceable to single ascension-pipes might, in the long run, be more costly than the provision of the second ascension-pipe.

Temperature and Carbonization.

Once again the delivering of the Cantor Lectures of the Royal Society of Arts has been entrusted to Professor Vivian B. Lewes, who has the priceless gift as a lecturer of imparting vivacity and interest to the most recondite and dry subject. The first of the series of four lectures was delivered on Monday evening last week; and, as will be seen, Professor Lewes is again attacking the, or some of the, problems of carbonization—problems that offer an inexhaustible field for the investigator and for the maker of hypotheses. The old theories of both practical carbonizers and scientific investigators regarding the complex actions occurring during the process of carbonization at various temperatures have of late years undergone such a multiplicity of shocks that if anyone who is an independent observer and investigator can now restore something like order where chaos still exists, he will be doing a service to the industries in which coal carbonization stands at the very head of the vital parts of their enterprise. Judging from the titular indications of his lectures, Professor Lewes is attempting to sort out the evidence as it exists to-day, rejecting that which experience and experiment do not enable him to accept, and showing the reason for establishing the remainder as sound, acceptable knowledge. If this is the correct statement of aim, and Professor Lewes succeeds in it, then the professional men of the gas industry will be profoundly thankful, as it is only by clear and proper understandings that, in such a matter

as carbonization, any substantial departure can be made from present approved practices. We have a vague idea of what is the ideal in the matter of results; but as to the best direction in which to work to obtain these results, there are many opposing views. In assisting to produce a settlement is where Professor Lewes hopes to come in.

The first of the series of lectures (the full text of which is published in this issue) will probably, in the end, be looked up as the least interesting of all. But intersecting all the learned statement as to the composition of coal, and the actions at various temperatures of the different constituents of the complex mass, there are several practical lessons for the daily worker for commercial ends in carbonization. Coals are of varied composition, and therefore coals require different treatment according to the main purpose for which carbonization is pursued; and, being of varied composition, for even one purpose—say, the production of gas—they require the employment of different temperatures in carbonization if the best effect is to be procured. Thus the advantage of chemical control. Only recently some in the ranks of the gas profession have been talking lightly of the deteriorating effect of the long exposure of coal to the weather, and saying that experience has convinced them that imagination has exaggerated what happens in fact, and that very little deterioration actually goes on. Others are of the contrary opinion—speaking also from experience; while still others assert deterioration starts quickly, and then proceeds at lessened pace until it practically ceases. Professor Lewes would say that all these opinions are more or less correct, but that they are subject to variation by differences in the composition of the coal; and that in the ultimate use of the stored coal for carbonizing, the gas, coke, and tar may all or severally suffer. But without a knowledge of the constituent and physical characteristics of the coal, no one can indicate the degree or direction of the greatest depreciation in respect of its designed productive end. The various actions that produce deterioration are lucidly explained by Professor Lewes; and if we follow him in these explanations with care, asseveration will in future be less dogmatic as to the negligible effects of weathering. It all depends on circumstances—circumstances which are largely inherent to the coal itself.

The theories as to the decomposition of coal at different temperatures are also treated upon. We see why it is that the hydrocarbons, together with the resin and humus constituents of the coal, undergo decomposition at lower temperatures than are required for dealing with the less volatile residues, and therefore why it is that for the manufacturer whose primary commodity is gas a high temperature is requisite to obtain the largest volume from the coal he uses. If the evidence that Professor Lewes now offers is pieced together, there is also a clear indication of the reasons why, in a process in which the operations of charging and discharging are continuous, the composition of the resulting gas is more uniform than is the case comparing the product at one period with another in bulk carbonization. The first lecture bids us hope for still greater interest in the second, third, and fourth.

Heating by High-Pressure Gas.

The second lecture by Mr. E. W. Smith, M.Sc., at the Manchester University, in connection with the Manchester Senior and Junior Gas Associations, was delivered on Saturday last; and he brings up-to-date experiences relating to the practical applications, in the Birmingham Corporation gas-supply area, of high-pressure gas to industrial heating operations. These further experiences confirm those he has recounted before, and fortify the already strong beliefs entertained as to the future part of high-pressure gas in industry. Experience in varied work in this connection must be progressive; and it is interesting to learn that almost week by week, where this clean, reliable, time-saving, and economical system of heating is in daily use, fresh—actual or possible—economy is brought to light. This is highly gratifying; for such experience do vastly more to firmly establish gaseous heating in our factories than any amount of learned disquisition, which manufacturers will not read, and of which, if they did, they might not grasp the full import. The prospect is therefore good.

This second lecture by Mr. Smith is of a very practical nature, treating for the most part of constructional details of burners and furnaces, and giving cost and time expenditure, under trial conditions, for certain work. All this will be particularly useful to those gas men who are studying the question of the use of gas in industrial operations, with the view to prosecuting business in this line among manufacturers, or who are requested to advise on the subject. It is highly essential in opening up a new line of enterprise of this kind that everything should be done to avoid mistakes in the appliances recommended and in the advice given; and protection against serious mistakes can only be ensured by preliminary investigation. It does not do for crude experimental work to be introduced, where it can be obviated, into the daily workings of a factory. Much harm and false impression may ensue, which will take time to eradicate, and so cause a set-back. Thus it is that the Birmingham Gas Department were wise in establishing a special laboratory and centre for dealing with this work; and the result of foresight has been the building of success upon success. The hints in the lecture will be most valuable to other and future workers.

Mr. Smith in the introductory part of the lecture acknowledges that, when he read his paper at the Glasgow meeting of the Institution of Gas Engineers, he had not seen certain service governors for high-pressure gas that have since been brought to his notice; and the tests that he has made of them, as now recorded, indicate, generally speaking, a very narrow percentage of pressure variation under widely different consumptions. Service governors for both high and low pressure gas supply have been much improved with the larger demand that in these times is being made for them. Mr. Smith has arrived at the view that gas will have to be governed both in quantity and pressure just as, in the distribution of electricity, amperes and voltages are watched in the dynamo room. This is a matter on which we should like Mr. Smith to enlarge a little more freely. Passing on, there can be no substantial argument over the point that, in heating work, one has greater control with high-pressure gas than with low-pressure gas and high-pressure air. With the former, there are no ill-effects encountered through variable pressures. The importance of this in manufacture cannot be over-estimated. For instance, in some coke-heated operations, the difficulty, through variable temperatures, of reproducing the best results, or having any positive certainty that what is required will be exactly produced, has been a cause of waste; and this is realized, in a very effective manner, through the disclosures made on the application of the system of high-pressure gas-heating. But though this is said, no one will dispute that, as Mr. Smith puts it, results comparable with high-pressure gas may be obtained with low-pressure gas and high-pressure air supply; but, through the absolute control in the matter of pressure that can be secured with the former system, it must be regarded as the preferable one. In view of this, it would be interesting to have some explanation as to why the Mint authorities have adopted for heating—in place of coke, and after experimenting with gas, electricity, and oil—low-pressure gas and high-pressure air for heating their furnaces and crucibles. The system on which their choice has fallen was the subject of an article in last week's "Journal" (p. 606). In the matter of methods and appliances, it has always to be remembered that the more they can be detached from the personal factor, and the scope for uncertainty be reduced, the greater the surety as to the result.

The accounts that are given in the lecture of various experiences point to the most sanguine of expectations in relation to the application of high-pressure gas in Birmingham industries having been more than fulfilled. Such method of obtaining high-temperature flames and heating has taken, so far as it is humanly possible to see, a permanent place in industry.

The "Daily Telegraph" Engineering Correspondent.

The Engineering Correspondent of the "Daily Telegraph" has sent a letter (published elsewhere) referring to the criticism and correspondence that appeared in last week's issue. This lettter is preliminary to a further reply that he promises; and therefore we will refrain from comment upon it until the extended communication is to hand. We hope, however, that the reply will not be long delayed, as the sooner it is received, the sooner will this matter be brought to the proper head. Meantime, those gas companies who have been desirous of ascertaining the name and address of the "Engineering Correspondent," in order that the Company concerned, may investigate the allegation as to dereliction of duty on the part of their maintenance staff, must endeavour to obtain

the information outside this office, as it will be understood the Editor has pledged himself to respect the desire for anonymity. The same with others who consider themselves involved in the controversy. There are people outside this office who know well the identity of "Engineering Correspondent," as we know by their voluntary communications; and, therefore inquiry in the right directions may produce the information required. Perhaps, however, if there is a little patience there may be an ending to this matter that will give perfect satisfaction. At all events, we hope so. So far as the gas industry is concerned, it is not a question of temper, but one of justice.

Enthusiasm in the American Commercial Gas Association.

In an editorial article in the "JOURNAL" for the 21st ult., we made special reference to the work of the American Commercial Gas Association—praising the enthusiasm of the members and appreciating the character of their endeavours. It will be remembered that the inception of this corporate commercial gas work in America was due to Mr. L. S. Bigelow, who strenuously advocated it in the columns of his magazine called "Light," but now known as "The Gas Industry." Mr. Bigelow is very properly proud of the magnitude and influence of the Association to-day, numbering as it does 3000 members, 700 of whom were registered at the recent conference at Denver—despite the original opposition in certain quarters. All have now come round to see the powerful influences that such an organization can have in the life of the American gas industry. In a letter of a friendly nature to the Editor of the "JOURNAL," Mr. Bigelow remarks on the enthusiasm existing in the Association; and he attests this by observing that Denver, where the recent conference was held, is 2000 miles from New York, and 1000 miles from Chicago—thus indicating the great distances that members had to travel to be present at the conference. We congratulate him and all concerned in the numerical prosperity of the organization. We hope that its aims and objects will be crowned by a success that will match the extent of the extraordinary membership—extraordinary for a gas association.

Smoke Abatement Exhibition Next May.

There are, we know, several firms who are, as it were, "sitting on the fence" in connection with the Smoke Abatement Exhibition to be held in London next May. The Institution of Gas Engineers and the Society of British Gas Industries are not officially having anything to do with the display. They have in view a great gas exhibition in 1913, in connection with which conferences will shortly commence. The absence of official recognition, however, on the part of the Society of British Gas Industries of the Smoke Abatement Exhibition next year, does not preclude any of the members of that body from individually taking part in it; but naturally the prospect of the 1913 exhibition rather inclines some firms to refrain from doing so. But there is another side to the question. As in Manchester, the electricity industry are sure to be represented at the show next May; and, therefore, it would be regrettable if the gas industry were not correspondingly represented. There are the questions of the cost of space, general expenses, attendance, and so forth; and the suggestion occurs that sufficient representation of the industry would be secured if there could be, on the part of the manufacturing firms, a large composite gas display, under an independent manager and attendant—say, something after the manner of the Shepherd's Bush exhibit.

Gas Matters in Manchester.

No doubt the members of the Gas Committee of the Manchester Corporation will be glad to hear of any means by which they can further the interests of the huge and prosperous undertaking of which they have charge; and thus it may be assumed that they will give due consideration to the remarks contained in an article under a *nom de plume* which appears in the local "City News," on "Things to Think Of, and Things to Do." They will, however, assuredly come to the conclusion that the writer does not advance matters very much in any direction, while some of his statements fall short of what is already well known. They are not likely to quarrel with the assertion that the gas undertaking is one of the best-paying departments possessed by the Corporation, and that its policy has always been so wisely directed and so ably developed that it stands in the very forefront of such enterprises in this country; and there will be equally general agreement that this position has been reached, and can only be maintained, by the ceaseless energy and whole-hearted devotion alike of Committee and officials, supported by the loyal confidence of the Corporation. There is, however, likely to be some difference of opinion with the author when he says that, though the introduction of incandescent mantles has naturally assisted to place the Gas Department in a better position to compete with electricity as a household illuminant, and high pressure gives it an added recommendation for shop and street lighting, it "would not be advisable to place too much reliance on these features." Of course, it is true that enterprise will have to be exhibited in making the most of every new development for utilizing the product of the works; but the gas industry does, and quite rightly so, place the greatest possible reliance upon the aid of incandescent lighting and high pressure in enabling it to successfully fight its battle against all competitors.

Prepayment Meters and Profits.

Then, again, there must be some mistake in the statement that there is (though admittedly groundless) a "strong antipathy against the use of prepayment meters." According to the annual accounts of the Gas Committee, the number of consumers on March 31 last was 181,356, which was an increase of 2866 over the previous year. Of this number, 63,663 used prepayment meters, or 2617 more than in the preceding year. It is curious that if there is a "strong antipathy" to prepayment meters, over one-third of the gas consumers should be found using them, and that in the last financial year the total increase in the number of customers should be almost entirely accounted for by the addition to the roll of prepayment-meter users. Perhaps more consumers of this class could be secured if gas was sold through prepayment meters at the same price as to ordinary consumers; but the figures show that, so far from there existing a "strong antipathy" to them, prepayment meters are highly popular in Manchester, as they have proved elsewhere. At the close of the article, the author refers to the question of the limitation of profits—pointing out that in Manchester the Trading Committees contribute about £144,000 annually to the rates, and that, if only 1 per cent. on the outstanding capital was allowed, this sum would be reduced to about £38,000—which would leave over £100,000 more (or a rate of at least 6d. in the pound) to be found by the ratepayers. The contribution from the Gas Committee, which last year amounted to £50,000, would, he calculates, be reduced to about £11,000 if the new principle were adopted. All this may be as stated; but it has to be remembered that gas consumers have certainly a "strong antipathy" to the principle of big surpluses being handed over in relief of the rates.

Labour Considerations.

When replying to a vote of thanks at the recent annual meeting of the Weardale Steel, Coal, and Coke Company, Limited, Lord Furness expressed the hope, which must be echoed in many quarters, that when they met again there would have been an end to the miserable unrest which now prevailed among the working classes. Perhaps it is not too much to wish that the employees of this particular Company at any rate will give some thought to the weighty conviction of the Chairman that the one class who suffer more than any other from this unrest is the working class—because, just as they put difficulties in the way of extending and developing the trade and industry of this country, so are they doing the greatest injury to themselves—and that no industry can long continue to pay good wages, and offer good conditions, unless it can give some reasonable return to those who find the money to create the enterprises which make employment for the great masses of this country. The reason for Lord Furness's remarks was clearly shown in his opening statement, where he pointed out that, whatever enterprise they might exhibit in adopting scientific methods of working, however much they might seek to promote efficiency of management, and whatever effort they might make for the amelioration of life at their collieries, none of these things was of any advantage to them as a Company. All the gain, and more than all of it, was devoured at the other end of the scale by a continuous enhancement of such items of cost as were beyond their own control, and by the disturbance due to strikes, labour unrest, and discontent in the industrial world generally, and specially among the coal workers. A falling off in profits has been experienced; and this result is

in a great measure due, it seems, to the many serious stoppages, involving loss of output and increased cost, caused by petty and trivial disputes raised by the workmen almost incessantly throughout the year. The total output of coal by the Company during the twelve months was 1,390,537 tons, compared with 1,418,651 tons in the previous year; the make of coke, 256,769 tons, against 304,149 tons; the production of ironstone and limestone, 18,159 tons, against 26,430 tons. And to secure these results, the Company employed about 500 more workpeople than they did in the preceding year! No wonder that this question of irregular working and consequent loss of output is causing the management increasing anxiety. It should, if they considered the matter properly, cause anxiety to the employees as well; and if it did so, the Directors would have the soundest justification for their hope that they will secure the co-operation of their workmen in an endeavour to remedy "what has come to be looked upon as a reflection on the reliability and steadiness of the average miner."

Nottingham Gas Engineer's Appointment.

In last week's "JOURNAL" (p. 587), when intimating the selection by the Nottingham Corporation Gas Committee of Mr. John Wilkinson, of Halifax, as Mr. Brown's successor as Engineer and General Manager of the Gas Department, the names of two others were given as being interviewed before the final choice was made. We are asked to state that the name of Mr. W. Gregson, the Assistant Gas Engineer at Nottingham, should be added as having been on the selected list.

Gas Supply in St. Petersburg.

From a letter recently received from a correspondent in St. Petersburg, we are pleased to learn that gas is not only holding its own, but is steadily gaining ground. In the domain of lighting, the inverted gas-burner is successfully competing with all the electric, petrol, and alcohol types of burners; while the many advantages of gas for cooking and heating purposes are being more generally appreciated by the Russians. In the thinly-populated district specially referred to by our correspondent—that served by the St. Petersburg Gas Company (a French concern)—there are signs that before very long it will become the centre of a densely inhabited area. Buildings of the most modern type are being erected on all sides; and the responsible officials of the Gas Company are looking forward with pleasure to having soon a fine field in which to do battle for the gas industry.

A City Engineer's authority to compel a water company to change the elevation of one of their mains was denied by the Omaha Water Company last year; and the Nebraska Supreme Court has upheld the refusal. According to "Engineering Record," the decision is based on the lack of any ordinance giving the authority; and in its absence, the only legal way in the United States to direct a private company to change the grade of their pipes appears to be by the passing by the city council of a suitable ordinance directing the change to be made.

Pumping water electrically for supplying cities is being done extensively in Illinois; current being furnished by private companies for the purpose at 2c. to 5c. per kilowatt-hour. Where the company produces current economically, steam pumping plants of small size are more expensive to operate than electrically driven plants, as at Lincoln (Ill.), where a million gallons of water are pumped electrically with about 3 tons of coal less than by either of two steam-pumps. The North Shore Electric Company, supplying current to places north of Chicago, furnish current to a municipal plant having both deep well and centrifugal pumps. They are started and stopped automatically, and in this way they keep the reservoir constantly full. Sometimes current is sold on the basis of the quantity of water pumped; but where this is done, it is claimed by some managers of central stations that the company should maintain the pumps, to prevent losses by their unsatisfactory condition.

At a recent meeting of the Chemical Society, Professor Harold B. Dixon, F.R.S., of Manchester University, a Past-President of the Society, delivered the "Berthelot Memorial Lecture." M. Pierre Eugène Marcelin Berthelot was born in Paris on Oct. 23, 1827, and was educated at the Lycée Henri IV. In 1865, he was appointed Professor of Organic Chemistry at the College of France, and held the position till his death. The French Academy of Medicine admitted him as a member in 1863. He was elected to the Academy of Science in 1873; and of this body he succeeded Pasteur as Perpetual Secretary in 1889. In 1900 he became one of the French Academicians. In 1877 he was elected a foreign Fellow of the Royal Society, and a Davy Medal was awarded in duplicate to him and to his friendly rival in thermo-chemistry, Julius Thomsen, in 1883; while in 1900 the Royal Society bestowed upon him their highest distinction, the Copley Medal. He was also a Fellow of the Chemical Society. The career of the illustrious chemist came to an end in 1907; he and Madame Berthelot dying together on the 18th of March.

GAS STOCK AND SHARE MARKET.

(For Stock and Share List, see p. 713.)

THE Stock Exchange has had another very poor week; and it almost looks as if markets were already beginning to compose themselves to sleep for the Christmas holidays. There was but little either of inside dealing or outside support from the public. At times, things looked as if they were going to liven up a bit; but there was no backbone in it. The opening on Monday was very quiet and rather shy; but before long the tendency took a brighter turn, inspired by Consols, which responded to inquiry by rising $\frac{3}{16}$. Railways followed suit and closed stronger; and Americans rose after some hesitation. The Foreign Market was nervous over international questions. Tuesday began well, but gave way later without any grave cause being apparent. Consols were lower on realizations. Rails receded and closed at the lowest of the day. Wednesday was inanimate and dull. A failure was announced. Consols went down at the stiff contango for the settlement; and the other chief departments were weaker. On Thursday, dulness was accentuated. Consols fell $\frac{1}{8}$, Rails were in suspended animation, awaiting the jump of the Labour cat, and the rest felt the general depression. On Friday, Railways picked up—discerning better prospects of a pacific settlement. Government issues were, however, quite dull. Business on Saturday was fair; and the cheerfulness in Rails was quite maintained. But Government issues did not improve; and Americans failed to make any recovery. Consols closed at $77\frac{1}{8}$ to $77\frac{1}{2}$ *ex div.*—equal to a fall of $\frac{3}{8}$ in the week. In the Money Market, there was a good demand for Stock Exchange and month-end requirements, and discount rates were harder. Business in the Gas Market was about on the normal scale; and the general characteristic was steadiness, in the absence of any incident calculated to influence a movement either way. The quotations of only one or two foreign undertakings made the slightest change. In Gaslight and Coke issues, the ordinary was at about its average pressure, and changed hands at figures fractionally better than last week—$104\frac{1}{2}$ to $105\frac{1}{4}$. In the secured issues, the maximum realized 86 and $86\frac{1}{4}$, the preference from 103 to $103\frac{1}{2}$, and the debenture 81 and 82. South Metropolitan was very little dealt in, and was unchanged at $116\frac{1}{8}$ to 117. In Commercials, the 4 per cent. was done at $110\frac{1}{4}$ and 111, and the debenture at $76\frac{1}{4}$. Among the Suburban and Provincial group, Brighton ordinary was marked at $158\frac{1}{2}$, Bournemouth "A" at $29\frac{3}{8}$, ditto "B" at $16\frac{1}{2}$ and $16\frac{3}{8}$, ditto preference at $14\frac{1}{2}$ and $14\frac{5}{8}$, Southampton at $106\frac{1}{2}$ and 107, Wandsworth and Putney "B" at 143, and ditto debenture at $73\frac{1}{2}$ and $75\frac{1}{2}$. In the Continental companies, Imperial was rather active at improving prices, marking from $184\frac{1}{2}$ to $185\frac{3}{4}$ (a rise of 1), Union was done at 89 (a fall of 2), ditto preference at 135 and 136, and European at from 20 to $20\frac{1}{4}$. Among the undertakings of the remoter world, Cape Town debenture changed hands at 80, Monte Video at $12\frac{1}{4}$ and $12\frac{3}{8}$, Primitiva at $7\frac{3}{8}$ to $7\frac{5}{8}$, ditto preference at $5\frac{3}{16}$ to $5\frac{5}{16}$, and San Paulo at $10\frac{1}{2}$ and $10\frac{5}{8}$.

ELECTRICITY SUPPLY MEMORANDA.

Saddling the Wrong Horse—Professional Conduct—"Tricity's" Campaign—Electricity in Coal Mines—The Mystified Consumer—Misrepresentation in Lamp Ratings.

OUR electrical friends are constantly fulminating over the daily newspapers, when fires are caused, or suspected to have been caused, by the fusion of electric wires or short-circuits, notifying the fact to the public. So far as electricity is concerned, electricians would like "*Suppressio Veri*" to be the motto of every newspaper man. But truly we do not think they have much of which to complain in comparison with the gas industry; for all over the country the latter have been recently saddled with the delinquencies of electrical systems, and have had to bear the calumny, for there has been no one, so far as we know, who has thought it his business to put the newspapers right on the subject. The newspapers have not as yet become cognizant of the fact that, in an electric street culvert, there are all the requisites for the manufacture of an explosive mixture of, among other qualities, a most nauseating and suffocating order. The fusion of a cable, and the action of the heat on the bituminous covering, and the result means peril for persons and property alike. It was Long Acre that gave us an ugly experience of this not long ago. Now we have the Strand and Nottingham experiences, so far as the evidence enables the formation of judgment. But throughout the country, in the pictorial and ordinary papers, both occurrences have been labelled as "gas explosions." We have before us a daily paper in which is reproduced a photograph of the Albert Hotel, Nottingham. The ruin shows the violence of the explosion there; but at the top of the picture, we have the words "Hotel Wrecked by a Gas Explosion at Nottingham." The layman in these matters naturally associates this with the gas supply which he knows from daily use. What were the facts at Nottingham? There was a smell of burning bitumen; smoke was seen issuing from the pavement; the electric cable was discovered fused; and the gas-pipes in the neighbourhood after the explosion were found tight and intact. There was the Glasgow flour-mill explosion quite recently. That also was labelled in the daily press as a gas explosion; and the strictest examination could not find a trace of gas about the

place. All experts are agreed that it was a flour-dust explosion. The fearful catastrophe at Liverpool has also been described and talked about as a gas explosion. No doubt it was, and there may have been electric ignition; but the gas was not the kind with which the gas-supply industry does business. It was, however, discussed in trains and in houses, through improper newspaper description, as a "gas" explosion. While it ought to be someone's business to have such proved misrepresentation in the Press corrected, the gas industry will endeavour to bear the burden resignedly and with dignity, instead of—as is sometimes witnessed when, with stronger reason, fires are attributed to electric wire fusion—raving about the matter.

The Institution of Electrical Engineers are now revising their articles; and in the technical press of the sister industry and at the meetings of the Institution, there has been such an outflow of language over the subject that there has not been time, with many other matters claiming more immediate attention, to digest it all. Among other things there has been much said and written on the subject of rules for professional conduct. As we say, we have not looked very carefully into the subject; but we may hope that, among the professional conduct rules, will be found one dealing with the professional electrical engineers' advertising literature, and that ignominious failing of theirs of "bearing false witness." If a "conduct" rule has not already been established in relation to this ethical matter, we recommend it to the Council of the Institution of Electrical Engineers as one requiring urgent consideration, before finally closing the present revision.

The "Tricity" cooker people, as a result of the recent Olympia exhibition, are apparently not so busy as they would like to be. Already they have had a page advertisement in the "Standard," describing the merits of electric cooking by the "Tricity" plan, and practically promising long life to those who read, if they give the phrases the full richness of meaning that is intended, and buy "Tricity" appliances. The page advertisement is in the form of an illustrated article. Its authorship is attributed to "A. Rosenthal, 'Standard' Special Commissioner." We have never, to our knowledge, met this gentleman, but as we have on more than one occasion our "Tricity" friends, we recognize that the good Rosenthal has drank deeply at the fount of "Tricity" wit. He starts his article by stating that the public generally will hail with delight the announcement that cooking by electricity is now far more economical than by any other method. We have failed to discover any ebullient delight on the part of the public over the advertisement statement. The intelligence of the public will not allow them to take all for granted that electrical folks choose to tell them. The public wants to know why it is that the electrical people talk in one breath of lighting by electricity being responsible for less heat than gas lighting, and in the next of work requiring heat being accomplished with greater economy by electricity than gas. The electricians cannot have it both ways. After that the "'Standard' Special Commissioner" goes on to speak of poisonous fumes; and among other of his pseudo dicta, he states that the faces of the poorer classes who burn coke are pale and emaciated. Why coke more than coal? "They are consumptive and weak generally; but it would be unnatural to expect anything different." Hundreds of thousands of tons of coke are sold, and have been sold, annually in this country for decades to the poor people; and therefore we should much like the "'Standard' Special Commissioner" to give his authority for the statement he makes.

What suicide has got to do with cooking, we do not know. But Mr. Rosenthal's first duty appears to be to endeavour to terrorize. His readers are consequently informed that "in France the general method of committing suicide is by inhaling the fumes of charcoal. Sometimes gas is used; but either method is fatal." Are the merits of cooking by the "Tricity" appliances so poor that they must have this sort of thing to support them? Then we go on to read of housewives rebelling against standing over "poisonous fumes" every day, and about cooks grumbling at having to do the same thing. Is this the reason why the use of the gas-cooker is increasing by leaps and bounds? Then that miraculous saving in meat that the "Tricity" people claim is trotted out. It is a strange thing that they refuse to tell us the gas-stove in which the tests have been made, and the other details necessary to test the veracity of their figures, to ascertain the ground for the phenomena, and to investigate whether all gas-stoves and all cooks would have a like experience. Why keep the particulars secret as to these tests? If the statements cannot be refuted, there is no reason for making any secret of the information we have more than once asked for. We have several times now also desired information as to the lines of the tests on the relative heating efficiencies of gas and electric cookers that the public have been informed have been carried out on behalf of the electrical industry. But these are not disclosed. Why not? We shall be forced into thinking that these heat efficiency tests are more mythical than our friends may really care to acknowledge. If all these things are true, why is it necessary for the "electricity supply corporations, as is now a matter of common knowledge, to supply the electricity at a reduced price for cooking purposes." Really we sympathize with Mr. A. F. Berry—the designer of the "Tricity" cooker—for having been given such prominence in a trade advertisement as Mr. Rosenthal has thought fit to accord him. One of the sections is headed "A Brilliant Inventor." Mr. Berry must have blushed when he saw this in the "Standard;" and his gentlemanly nature must have revolted against such publicity being given to his personal professional qualities. This is the sort of advertisement that one sometimes sees prior to the issue of a prospectus. Surely those constituting the Berry Construction Company, Limited, are not thinking of letting all and sundry who desire participate in the gold mine that the "Tricity" cookers offer. If so, they would be robbing themselves and their children. Perish the thought!

The electrical industry are wrathful with the Government for their obstinacy—obstinacy in a good cause—in declining to relax the limitations to the use of electricity that they are proposing under the Coal Mines Bill. One section provides that if in any part of a mine, or of a ventilating district of a mine, the amount of inflammable gas in the air currents exceeds ½ per cent., the use of electricity shall at once be discontinued. There has been an attempt to get this provision on behalf of the electricity industry eliminated; but the opposition, both from the Government and in the House generally, has been too strong. People are not now taking the "safety" of electricity at the valuation that electricians choose to arbitrarily put upon it. In the discussion on the matter, Sir A. Markham declared that any man who took a motor into a mine where gas was present was a madman, because there was not a single electric motor constructed that was gas-tight. There is no doubt about it, miners are genuinely alarmed over the use of electric motors in mines; and although far be it from us to say that economical methods should not be introduced where safety is assured, we cannot but agree with the submission made on behalf of the men that it is more important to have mines that are safe than to introduce danger for the sake of economy. The rigid attitude of the Government in this matter is seen by the statement made by Mr. Masterman that the more evidence the Government obtain, the more they are led to insist on the same conditions for the introduction of electricity as for the introduction of naked lights in mines. "I do not think it is extravagant to lay down that, where a naked light is not permissible, electricity should not be allowed to be used." That is a rule the electrical industry will not appreciate.

We are always having electrical uses presented to us from the electricity vendors' point of view; and therefore it is interesting to have it for a change from the consumers' point of view. "K," as a consumer, contributes an article to the "Electrical Review." He uses electricity at the office and at home. He bought a kettle (which transaction gave him a shock on ascertaining the price) for use at the office. After a time he transferred the kettle home. Result, a telephone message at the office one day that the kettle had "exploded." There was no light at home that evening. It was explained to him that this was due to the difference in voltage. The repairs to the kettle cost 8s. 6d. With the use of the kettle, the electric lighting bill went up enormously; and then he learned that he could have the current cheaper by having the place rewired, and paying the rent for a second meter. This raised the question why he could have energy to boil the kettle at 1d. per unit; while for lighting he had to pay 5½d. A suave gentleman from the electrical company told him that it was due to the fact that the kettle was used at a time different from that of the lighting. But the customer explained that, when he had tea at the office, it was generally at the time he was using the electric light. The suave gentleman smiled, and took himself off. Another grievance is that, when there is a fog, the light obtained from the electric lamps causes further exasperation. Then he complains of the alterations he had to have made when metallic filament lamps first came in, and had to be run in pairs. Then came the lamps that would run singly; and there followed another bill for alterations. Then the installation expenses for a kettle and a radiator (apart from their own cost) ran him into a bill for £3 10s. Altogether he has four meters in use—his offices extending over four houses—two meters for lighting, one for the kettle at one end of the offices, and one for the radiator at the other end. This is how this mystified consumer ends his plaint: "When I realize that I might have accepted the gas company's offer to lay new pipes to all my eighteen rooms for lighting and fires for nothing, and give me one service through one meter for the whole lot, with 25 per cent. discount because of the stoves, and charge me—I think it was—1s. 6d. per quarter per room to look after the whole lot, I wonder whether I am not a bigger fool than I look!"

Mr. Leon Gaster was always strong on electric lamp misrepresentations. We learn from an electrical contemporary that he has been speaking on behalf of the electrical trade section of the London Chamber of Commerce before the Select Committee on Misrepresentation in Trade. In the course of his evidence, he declared that the figures marked on electric lamps to indicate the voltage, power consumed, and candle power, were in many cases quite incorrect. As an example, he referred to the results of tests upon batches of lamps supplied to a Government department. These lamps were supposed to be according to a certain specification; but on examination of several batches, it was found that nineteen out of 40, seven out of 38, and seven out of 40 were "useless." Their life was supposed to be 800 hours, but was actually as much as from 40 to 70 per cent. below this figure. If this is the case with lamps made according to specification, what must be the condition of lamps supplied to the public without any specification at all? What, indeed! Misrepresentation in electric advertising literature, misrepresentation by canvassers, misrepresentation by lamps; and nowhere available a Well of Truth large enough to effect conversion.

Sir Scott Foster, the re-elected Mayor of Portsmouth, is a Director of the Portsmouth Water Company.

PERSONAL.

The Water Committee of the Salford Town Council have selected Mr. L. H. A. GAUNT, of Warrington, for appointment as Water Engineer and Manager—the commencing salary being £300 per annum. The selection has yet to be approved by the Council.

Mr. A. A. KAY, of Streatham, completes this year fifty years' service in the South Metropolitan Gas Company; having commenced as a messenger boy at the age of ten. At that time Mr. Thomas Livesey, the father of Sir George Livesey, was the Engineer of the Company. Mr. Kay is now one of the prepayment meter collectors.

OBITUARY.

GEORGE BOWER.

By the death of Mr. George Bower, which took place at his residence at St. Neots in the night of Tuesday last, at the advanced age of 85, there has been removed another of the few remaining personages who occupied a prominent position in the gas industry in the past, and a life which, till comparatively recently, was full of activity, has been brought to a close. Mr. Bower suffered from the effects of a paralytic seizure about two years ago, which confined him practically to one floor of his house, but he retained all his mental faculties; and though he had not been so well as usual during the few days prior to his death, no immediate danger was suspected. He retired as usual on Tuesday night; and next morning it was found that he had passed away in his sleep.

Mr. Bower was born at Caistor, in Lincolnshire, on April 14, 1826. He commenced business as an ironmonger at St. Neots in 1850; but the engineering department grew so rapidly that about seven years later he devoted his entire attention to it. It rapidly developed into a very large concern; and Mr. Bower's name as a gas and water engineer became very widely known. In 1876, he sustained great financial losses in South America and Russia; and he never entirely overcame the disaster.

Soon after he commenced business, he figured as a patentee; his first patent being taken out in 1852, for improvements in gas-stoves and fireplaces. This was followed the same year by one for improvements in the manufacture of gas for illumination, and consisted in making retorts with ridged bottoms for the purpose of increasing the heating surface, and in a mode of combining in one apparatus hydraulic main, condenser, washer and scrubber, and purifier. The next patent was taken out in 1857, for improvements in manufacturing gas, which consisted in feeding and discharging retorts by an Archimedean screw worked by hand for private gas making and by power for public works. Another patent was obtained in 1859 for improvements in apparatus for the manufacture of illuminating gas, and consisted in arranging a vertical retort fed by an Archimedean screw, and suitable for either coal or oil. The next patent was in 1860, for a vertical retort, and a governor with a ball-joint valve of parabolic form. This was followed by another in 1863, for the production and transmission of gas and other fluids; while another taken out the same year was for the purification of gas and the reduction of ores and the smelting of metals. In 1868, Mr. Bower took out a patent for a gas-engine consisting of two cylinders placed diagonally, and oscillating on hollow trunnions with both piston-rods attached to the same crank-pin.

For the next seven or eight years Mr. Bower was much engaged in the erection of gas and water works; so that he had little time for inventing. In 1876, however, the publication of Professor Barff's discovery of a means of producing a protective coating of magnetic oxide on iron and steel surfaces led him to carry out a long series of experiments with the view of finding out whether what the Professor did with steam could be accomplished with air; and he discovered a process which he patented. This was followed by other patents, in which his eldest son (Mr. A. Spencer Bower) joined, for developments; and in the end the two processes were worked together as the "Bower-Barff process"—separate companies being formed for the Continent of Europe, England, and America.

When the electric light scare came, a stop was put for a time to the erection of gas-works. Mr. Bower and his son then turned their attention from the production to the consumption of gas, and the Bower gas-lamp was the result. He also patented a system of lighting railway trains with high-pressure gas; while his son devised a regulator which delivers gas at any pressure, from 1000 lbs. to the square inch in the cylinder to a column of water half-an-inch high at the burner, and maintains it at this pressure under every difference of pressure in the cylinder. In the Exhibition of 1862, Mr. Bower exhibited a gas apparatus for private houses; and in October of the same year he received a commission to light up with gas the palace of the Viceroy of Egypt—3000 lights to be provided.

Mr. Bower married in September, 1850, Miss Sarah Spencer, daughter of Mr. and Mrs. Charles Spencer, of Higham Ferrers; and they celebrated their diamond wedding last year. Their surviving sons are Mr. Anthony Spencer Bower, of St. Neots; Mr. G. Spencer Bower, K.C., the well-known barrister and author; and Mr. Charles Bower. Two sons are dead. Mrs. Bower survives her husband, who in the public life of St. Neots for many years took a prominent part. He was a Town Commissioner in 1857, and was elected Chairman of the Local Board on its formation in 1876. The latter position he occupied for twelve years. He was particularly interested in the formation of the Gas Company, and subsequently of the Water Company. He was a zealous Churchman and in politics a keen Conservative.

The funeral took place last Saturday, when striking evidence was afforded of the great respect in which deceased was held.

Sir HENRY HARBEN, the President of the Prudential Assurance Company, whose death, at the age of 88, took place last Saturday morning, was a Director of the New River Company, by virtue of the possession by the Assurance Company of a complete share in the undertaking.

The death is announced, in his 91st year, of Mr. FREDERICK MORSE, one of the greatest benefactors of the local institutions at Lowestoft. He was a founder of the Lowestoft Water and Gas Company, and for a considerable period was Chairman of the Board of Directors.

The death occurred on Sunday, the 26th ult., of Mr. WILLIAM CORFIELD, who for a period of twenty-five years was Secretary of the Falmouth Gas Company—a position which he was obliged to relinquish some months ago on account of continued ill-health. He won the respect and esteem of all classes of the community by his courteous demeanour.

Mr. JOSEPH HOLT, Vice-Chairman of the Wilmslow and Alderley Edge Gas Company, died last Thursday, in his 74th year. He was for many years a member of the Wilmslow Urban District Council, and at one period was Chairman of that body; and at the time of his death he was a member of the Local Administrative Committee of the Cheshire County Council.

PETTY VINDICTIVENESS.

Charge for Energy for Electric Motors Driving Gas-Compressors.

ARISING out of the controversy that has been proceeding with the "Engineering Correspondent" of the "Daily Telegraph" is a matter that indicates the descent of some of the electricity suppliers in London into petty vindictiveness against those shopkeepers who adopt high-pressure gas lighting, and are compelled, through being off the pipe route of a central high-pressure distribution system, to have an independent compressing plant for the purpose. As is well known, the small amount of power required for driving a gas-compressing plant for a fairly considerable installation of high-pressure lamps makes the electric motor a very convenient method of driving. The gas industry freely acknowledges this so far as isolated plants are concerned. As a matter of fact, the gas industry has never, though rivals in the power field, refused to concede that there are purposes for which the electric drive is preferable to the gas-engine. In their own manufacturing practices, they evidence the view; for in the modern operated gas-works, where horizontal retorts are established, the varied operations of the stoking machinery are best performed by electric motors—the energy being generally produced by gas-driven generating plant. On the other hand, other forms of power will probably be found running economically on the same works for a different purpose. The choice of the form of power must, of course, be directed by economy and suitability. Where the gas-engine is a convenient and suitable means of power, there will be found economy, providing the gas vendor supplies gas at a reasonable power price.

In the examples of high-pressure gas lighting referred to last week (p. 597), we have instances of the petty vindictiveness to which we have referred in connection with the charge for energy for driving motors for the compressing plant. In one instance, we have the maximum lighting charge allowance by Parliament made for this power purpose—viz., 8d. per unit. In a second instance, it is mentioned that the consumer was charged a high price for the current used for the motor that was driving the compressing plant. We have knowledge of another case where an electricity company tried to force a charge of 5d. per unit for the motor used with a compressor, though electric power was being employed for other purposes in the same factory at 1½d. per unit. Such an instance as this only accentuates the spitefulness with which consideration is given by the electricity suppliers to the purpose for which the motor is used, instead of the purpose for which the current is employed. Many more instances in London could be cited. The electricity purveyors speak of 1d. per unit (sometimes slightly more, sometimes less) for power and heating. This is a power use, simply and solely—the power being required for raising the pressure of gas. There the "use" of the current ends; it is not, *per se*, "*used* either directly or indirectly for lighting." By their action in making these exorbitant charges, the electricity companies are only forcing the gas companies to expedite the provision of central station high-pressure supply (which is more economical for the consumers) in the stead of independent private installations driven by electric motors. At these central stations, gas-engines are used for the work; so that the electricity purveyors lose the custom of the owner of the independent gas-compressing plant.

The London suppliers of electricity take refuge behind section 7 of the London Electric Supply Act, 1908. This section gives

authority to charge a price not exceeding £6 15s. per kilowatt per annum of the maximum power required to be supplied, and ½d. per unit for all energy supplied: "Provided that no authorized undertaker shall be bound to give a supply upon the terms of this section in any case where the maximum power required to be supplied is less than 2 kilowatts. For the purpose of this section, the expression 'power purposes' shall include all purposes to which electrical energy may be applied other than for use either directly or indirectly for lighting." We do not suppose that when the clause was originally drafted, there was the slightest idea in the minds of the suppliers of electricity as to the application of the final words of the proviso quoted to motor driving for gas-compressing purposes. But the electricity suppliers claim that, under the interpretation of "power purposes," they have the right to charge any unreasonable price per unit they like up to the maximum allowable for lighting by their statutes. Further, there is the provision that "no undertaker shall be bound to give a supply upon the terms of this section in any case where the maximum power required to be supplied is less than 2 kilowatts." This, of course, means that the electricity suppliers have the right to make any charge they like for motors of less than 3-horse power; and, as is well known, the majority of the motors used for private gas-compressing plants are under this power. Technically, the vendors of electricity in London may be (we do not say "are") acting within their power in charging any sum per unit they like for power within the statutory limits. But, if so, the exercise of the power is unjust, and not at all dignified on their part. The question of these extortionate charges has not been dealt with by the Law Courts to ascertain whether or not the electricity suppliers are acting *ultra vires*.

With regard to the point as to not being bound to supply at a price per unit below the figures named, for motors consuming less than 2 kilowatts, it may be pointed out that very small motors are supplied in London (such as for driving hair-brushing machinery) for 1d. per unit. It is argued by the electricity suppliers that the gas-compressing machinery is used during lighting hours. There is no time limitation for the motors, heaters, cookers, &c., that are supplied during lighting hours in London at 1d. per unit or thereabouts, and to differentiate between motors used for driving gas-compressors and the other low-priced applications is significant of something that is not altogether creditable to the electricity suppliers. It is surely a matter for some compromise. There would be no objection, for instance, to paying 1½d. or 2d. a unit for electricity for the purpose of gas compressing—that is to say, a price somewhat higher than the charges to tradesmen and domestic consumers for small power or heating purposes. But to show anger and vindictiveness by charging such prices as 5d., 6d., and 8d. per unit for driving motors for gas-compressing is, to say the least, unbecoming of electrical business men.

The Act of 1908 does not apply to the Provinces or anywhere outside the Administrative County of London; and the only enactments that appear to bear directly or indirectly on the subject are found in clauses 18, 19, and 20 of the Electric Lighting Act of 1882. In clause 18, the undertakers are prohibited from prescribing any form of lamp or burner in connection with the use of the energy; clause 19 imposes on the undertakers the obligation to supply; and clause 20 reads:

> The undertakers shall *not*, in making any agreements for a supply of electricity, *show any undue preference* to any local authority, company, or person; but, save as aforesaid, they may make such charges for the supply of electricity as may be agreed upon, not exceeding the limits of price imposed by, or in pursuance of, the Licence, Order, or Special Act authorizing them to supply electricity.

The 1908 Act appears to cover the London electricity suppliers in doing that which the Act of 1882 says they shall not do—that is, show "undue preference."

Co-Partnership Gas Companies.—The current number of the "Co-Partnership Journal" of the South Metropolitan Gas Company contains a list of the gas companies who have adopted co-partnership, commencing with the South Metropolitan Company in 1889. Those added during the present year are the Bridgwater, Harrow and Stanmore, Longwood, Merthyr Tydfil, and Plymouth and Stonehouse. The total amount of share and loan capital of the undertakings in the list is £47,882,551. The Carmarthen Gas Company introduced a co-partnership scheme in 1909, but have since substituted a bonus arrangement.

Lectures on "Illumination and Photometry" at the London University.—We learn from the Provost of University College that in the Faculty of Engineering a special course of advanced lectures on "Illumination and Photometry" is to be delivered by Mr. W. C. Clinton, B.Sc., Assistant-Professor of Electrical Engineering, beginning Wednesday, the 10th prox., at 6.30 p.m. There will be eight lectures in all; and the following subjects will be dealt with: The nature, sensation, and production of light; radiation and matter; photometry and photometers; illumination from a single source; interior and exterior illumination. The lectures will be prepared for those who already have some practical acquaintance with modern lighting problems and requirements and are desirous of extending their knowledge of the physical principles underlying the subject. Laboratory work in illustration of the lectures will be arranged for a limited number of those who attend them. Particulars may be obtained on application to the Secretary (Mr. W. W. Seton), University College, Gower Street, W.C. The fee for the course will be £2 2s.

THE "ENGINEERING CORRESPONDENT'S" PRELIMINARY ACKNOWLEDGMENT.

A Full Response Later.

THE "Engineering Correspondent" of the "Daily Telegraph" sends the following letter for publication, which, it is understood, may be taken as preliminary to a full reply to the criticism of his articles appearing in last week's issue. This being so, editorially we will not deal with this interim communication, but reserve comment until full response is made. Meantime, one or two other correspondents have forwarded letters for publication; and these follow the one from "Engineering Correspondent."

SIR,—I have read with very great interest every word bearing upon my recent articles, in your "JOURNAL." I wish to merely mention the following points at this stage.

(1) I was astonished at (and appreciated to the full) the almost complete absence of what, for want of a better word, I will call spitefulness, in your own article and, in general, that of your correspondents. While that spirit maintains, I am, indeed, sanguine of a useful result of the discussion. My astonishment was possibly due to close observance of the way in which this sort of thing too often degenerates into personal abuse.

(2) A reply is due to Mr. Shadbolt. I venture to thank him for the dignified manner in which he protests. He, at any rate, will not use his high position for any quibbling. But I beg leave to quote Mr. Yates (on p. 609 of the same issue): "Another point which I would respectfully commend to gas-apparatus makers is the matter of the technical education of their staffs. If the rule-of-thumb is really to yield to the rule-of-three, it is obviously of vital importance that the staffs in the various works should be taught to know the accurate methods, and to prefer them to loose and 'sloppy' ways." Again: "In this connection, I cannot refrain from expressing the regret which many of us must feel that so little advantage should, as yet, have been taken of the great opportunities offered by the establishment of the Livesey Chair of Gas Engineering at Leeds University. This Chair was founded by the gas industry; it filled a real and great want; and the Committee were fortunate in securing a Professor of wide fame—I might well say supremacy—in his subject. That subject is *our* subject, and that Chair offers the very thing which our industry stands so greatly in need of. Yet the number availing themselves of the opportunity has hitherto been disappointingly small. I cannot too strongly urge on all connected with the gas industries the clamant need for their personal interest and effort in making the value of this provision known, and extending its usefulness. Employers would do an excellent thing for themselves by encouraging and facilitating, even at some cost, the use by their staffs of the advantages offered at Leeds." My own impression on the point seems to have been one fairly generally expressed from time to time in the "JOURNAL." But I really think that the past efforts will always be a matter of opinion. It would be worth almost any criticism of past words if I felt that I could, in however small a measure, be instrumental in increasing the demand for what I will call German applied science methods in any branch of industry of this country.

(3) Mr. Clark's figures are valuable. They will be carefully checked.

(4) Messrs. James Keith and Blackman make a straightforward offer. An effort is being made to take it up.

(5) Your reply was—pardon, no patronage is here intended—clever, and in many places extremely good. It was, however, marred especially by the Woolwich lamps. Those top lamps, as you must have known, cannot affect the photometer readings mentioned by 5 per cent.; and no greater accuracy was claimed. You spoil your own good points by the way in which you deal with that case. However, I will reserve a full reply until later.

(6) The letter from Mr. E. W. Smith (Birmingham) is worth—in my humble opinion—the whole of the other columns put together. Is this one of the "new" men? There is nothing petty or narrow here. A man who will face facts, and who sees into the future. "The controversy is opportune; and nothing but good to the gas industry can come of it"—to quote the letter. Yes—that's the spirit of the scientific man—and the rest of it, down to the last paragraph: "Might I suggest that the 'Engineering Correspondent,' when convinced of the economic advantages of gas lighting, should explain to the readers of the 'Daily Telegraph' the relative advantages of gas and electricity for 'power' and for industrial heating purposes under various conditions of working. An unbiassed article on this subject would be invaluable." I am just now preparing a review of the year's applied science progress for the "Daily Telegraph." Will Mr. E. W. Smith kindly send along any of his papers or data—the public shall know about it, so far as lies within my power. If there is going to be the sort of spirit which permeates this letter from Birmingham current in the gas industry in the next quarter-of-a-century, we shall indeed see some wonderful changes. It was worth all the trouble of the past few weeks, to bring out a letter like that.

(7) I say, quite frankly (after what I have found out *on my own initiative* during the last few days), that I should not express the same opinion again in such a manner as was done some weeks ago. In a sense, I regret the comparison—in other ways, I am thankful for it. I have learnt a great deal about the industry which you

claim to represent. As is shown under (6), I shall use some of the information. I am sanguine that, if only we can all keep our tempers, the result of this discussion will be of value, not only to gas, but to electrical and all the others who are called engineers—and especially to the nation.

THE "ENGINEERING CORRESPONDENT"
OF THE "DAILY TELEGRAPH."

Further Correspondence on the "Reply" by the "Engineering Correspondent" of the "Daily Telegraph."

A GAS AND ELECTRICAL ENGINEER'S EXPERIENCE.

SIR,—More able pens than mine can, if they will, give an effectual answer to the "justification" of the "Engineering Correspondent" of the "Daily Telegraph." The statements and arguments are indeed extraordinary, coming from a gentleman of the attainments claimed; and I fear, though I trust it will not be so, that many of those more particularly concerned in the statements may refrain from replying because some of the statements are too ludicrous, or from a sense of indignation.

It is well to see ourselves as others see us; but when plain truths are addressed to us, we have at least some reason to expect that our critic will know his case. Your correspondent appears to be ignorant of a great deal of the facts relating to the members of the gas industry; and he is particularly unfortunate in his references. For instance, anyone who wanted real information would not take the Woolwich electricity supply as an example; and the price of gas and electricity will vary in different localities. There are places in the world where it is the fact that, for lighting, gas is dearer than electricity. Then, again, with a huge power-house like that of the London County Council Tramways Department, with an ideal load both as regards output and period, electricity can be produced at a very low figure, *but not for lighting only*, which is the worst possible load from the electric supply point of view. It is, therefore, not of much use to compare costs in general terms. Current can, of course, be produced and distributed at 3d. a unit, more especially when standing charges in the case of a Corporation, or dividends in the case of a Company, do not matter. A more usual commercial figure would be 5d. or 6d. a unit.

It is my privilege to be in the service of a progressive gas company, and possibly this fact alone will be sufficient for your correspondent to suggest that I am incapable of giving an honest opinion on the subject of gas and electricity, to which suggestion I should naturally take strong exception. For myself, and for those with whom I come in contact, it suffices that, as a student, I was educated for gas and electricity work, and that for twenty years past I have handled work in connection with both industries. Electric lamps of all descriptions are utilized in connection with my work and constantly on test, and the laboratory on the works has been fitted for testing electric as well as gas lamps for many years past. I also am in the position of being a consumer of electricity from corporation mains, responsible for installation work under similar circumstances, a producer of electricity, and a seller of electricity. It would be strange indeed if, with these conditions, I did not appreciate the question of lighting; and I would point out to your correspondent that, without being a gas-fitter, it is possible for a consumer using a modern inverted gas-burner to have a regular duty or efficiency of over 20 candles per cubic foot of gas consumed. Osram lamps for domestic lighting yield from 750 to 800 candle power per B.T. unit.

From these figures it is easy to calculate the relative cost in any district. Also, in regard to public lighting, I have the opportunity daily of comparing many hundreds of street-lamps fitted with 55-watt Osram lamps, against gas-lamps fitted with "C" Welsbach burners consuming under 4 cubic feet of gas per hour; and in the ordinary way the comparison is not favourable to electricity.

For obvious reasons I must remain anonymous, and sign myself

Nov. 27, 1911. GAS AND ELECTRICAL ENGINEER.

ELECTRIC LIGHTING CHEAPER THAN GAS LIGHT.

SIR,—In connection with the articles which you are publishing, on "Some Aspects of Lighting," by the "Engineering Correspondent" of the "Daily Telegraph," I feel sure your readers will be interested to have some practical figures to study with your correspondent's calculations. I therefore have pleasure to ask you to insert this letter, together with the enclosed reprint from the "County and City of London Observer."

I should add that electricity is supplied to the institution referred to, on the maximum demand system, at 6d. per unit for the average use of the maximum demand for one hour per day, and 1d. per unit after. The price of gas is, I believe, 2s. 9d. per 1000 cubic feet.

L. L. ROBINSON, Borough Electrical Engineer.

Borough of Hackney Electricity Department,
Nov. 27, 1911.

[ENCLOSURE.]

Reprinted from the "County and City of London Observer."

At the fortnightly meeting of the Guardians of the Poor of the City of London Union held on Tuesday [Nov. 14, 1911], at the Board Room, Bartholomew Close, the question of lighting the Institution in Clifden Road, Hackney, was reported on.

THE COST OF LIGHTING.

The master reported that the cost of gas lighting in the chapel and dining-hall was far from satisfactory, owing to the varying pressure. The cost, including renewals, amounted to 5s. 10¼d. per burner for the winter quarter, as against 3s. 2¾d. for electric light, so that electric light was 2s. 7½d. cheaper than gas. He suggested that electric light fittings be installed. The cost of doing the work by the Guardians' own staff would amount to £25. The matter was referred to the House Committee for consideration and report.

[We do not think "Engineering Correspondent" will be prepared to accept the foregoing as a fair test of relative costs, without knowing whether the conditions are comparable. It would be interesting to learn the cost per unit of the electricity, the respective hours of lighting for gas and electricity, the actual respective candle powers afforded by each illuminant over the hours of lighting, and whether the gas-burners used are of a respectable inverted type. Our correspondent should digest the article and correspondence in last week's issue, and then consider whether he can, justly, defend his illustration. "Engineering Correspondent" was saying a fortnight ago that he "believes that electrical engineers are better trained, and have more knowledge of scientific measurement than have gas engineers." Of course, that was only his personal opinion.—ED. J.G.L.]

EXAGGERATED ADVERTISEMENT.

SIR,—By the same post I send you a copy of the current issue of our local newspaper, which publishes an advertisement of interest in relation to the "reply" of the "Engineering Correspondent" of the "Daily Telegraph."

For this advertisement the badly-educated, wicked gas man is responsible. Can the superior education of your correspondent enable him to say where a 50-candle power electric lamp can be found to fully equal the duty ascribed to it in the advertisement, or to refer to a single electrical advertisement as fair to the gas industry as this one is to the electricians?

Nov. 25, 1911. GAS MANAGER.

ITEMS OF INTEREST.

November, 1911.

This GAS-LIGHT CANDLE POWER, 80. [Burner Illustrated.]		This ELECTRIC LIGHT CANDLE POWER, 50. [Lamp Illustrated.]	
COSTS for ten hours—		COSTS for ten hours—	
At 3/6 per 1000 ft. .	1½d.	At 6d. per B.T.U. . .	3d.
At 4/6 per 1000 ft. .	2d.	At 8d. per B.T.U. . .	4d.

60 per Cent. More Light for Half the Cost.

THIS GAS-LIGHT

1 Keeps Expenses Down.
2 Keeps Goods Dry.
3 Keeps Apartments Warm.
4 Keeps Air Sterilized.

The Examinership in "Gas Supply."—Mr. Walter Hole, the Superintendent of the City of Leeds Gas Mains and Distribution Department, has been appointed by the Committee of the Department of Technology of the City and Guilds of London Institute, as Examiner in "Gas Supply," on the recommendation of the Council of the Institution of Gas Engineers; Mr. J. H. Brearley, of Longwood, having resigned the position.

Professor Lewes on the Carbonization of Coal.—At the Royal Society of Arts last night, Professor Vivian B. Lewes, F.I.C., F.C.S., delivered the second of his course of Cantor Lectures on the above-named subject. Having in the first lecture, which will be found in another part of the "JOURNAL," explained the composition of coal, he devoted the second to a description of the methods employed in its destructive distillation; indicating the changes which have taken place during the last century in the form of setting of gas-retorts. A report of the lecture will appear next week.

Interesting Presentation at Birkenhead.—Last Saturday week a handsome gold chain was presented by the workmen and staff of the Birkenhead Corporation Gas-Works to Mr. John Rixon on his retirement after 53 years' service. Mr. Rixon had served under three Engineers; having commenced his association with the department when the gas undertaking was owned and controlled by the Birkenhead Improvement Commissioners. He has seen the annual output of gas grow from about 75 millions to the present total of 826 millions. Mr. T. O. Paterson, the Engineer, in making the presentation, wished Mr. Rixon every success and happiness, and hoped he would be blessed with a good many years in order to thoroughly enjoy the retirement which such a long period of activity truly deserved. Mr. Rixon responded in words of thanks and appreciation for the kindness shown him and the good wishes expressed.

Patent Office Library Handbooks.—The library of the Patent Office, which has doubtless been found very useful by many "JOURNAL" readers residing in the Metropolis or its vicinity, has lately been undergoing re-arrangement, with the result that a new series of subject lists has been issued as guides to the general contents of the library. The lists preserve the same form as their predecessors, with the addition to the headings of class marks and work marks indicating the location of the books. It is convenient to be able to consult a book without having to hand in a ticket and wait for an attendant to bring the work indicated. This can be done at the Patent Office, and the lists under notice guide the searcher to the place to find what he requires. We have received the new list of works on peat, destructive distillation, artificial lighting, gas lighting, and acetylene, which has superseded No. 7 of the old series. These useful little books are on sale at the Patent Office, Southampton Buildings, W.C., at 6d. each.

DETERMINATION OF SULPHUR IN GAS.

THE SOMERVILLE TEST.

By C. Winthorpe Somerville.

The criticism of the Somerville sulphur test made by Herr J. Niermeyer, and noticed in last week's issue of the "Journal," calls for some comment from the author of the test.

The first experiments were carried out in March, 1909, as at that time it was very desirable to have a rapid method of estimating sulphur compounds by a more reliable process than the lead sulphide colour test. The first description of the complete test is dated April 5, 1909, in the author's laboratory log-book. Between that date and the publication in the "Journal," the process was tried and proved under all necessary conditions; and the various designs for the finished apparatus were tried and settled.

Herr Niermeyer states that the author has overlooked two points: (1) That the results should be corrected by an addition of 6 per cent., because all the sulphur is not burned to sulphur dioxide; and (2) that an excess potassium iodide must be used, as otherwise it is possible to find double the amount of sulphur which is actually present.

With regard to the first point, the author admits the interest attached to the investigations of Dennstedt and Ahrens, and their reliability; but he fails to see how they affect his process from a practical aspect. In gas companies, the total sulphur in gas produced from any coal is expressed in terms of grains per 100 cubic feet of gas, as determined by a process standardized by the Gas Referees; and a rapid process yielding results differing widely from those obtained by the accepted standard would be of little value. The Referees sulphur test was, therefore, the standard of comparison. The original experiments were made with a Referees burner and trumpet-tube, in place of the present combustion-tube, which gives more exact results.

Except in the case of sulphur as low as 5 grains per 100 cubic feet, where the disappearance of the colour is rather more gradual, and the end-point liable to be judged too early, the Somerville test gives results identical with the Referees to within 1 per cent. either way; and equally comparative results are obtained with other standard gravimetric methods in which the products of combustion are absorbed.

The accuracy of the test was checked and standardized against the Referees test, for the obvious reason that it is the accepted standard of gas companies. Therefore the first point that Herr Niermeyer puts forward was not overlooked, simply because it did not appear as a factor to be considered in the comparative working of the two processes.

With regard to the second point—that an excess of potassium iodide is necessary, as otherwise there is a possibility of finding double the amount of sulphur that is actually present owing to the volatilization of iodine—this is absolutely unnecessary; and the author suggests that if Herr Niermeyer used a larger volume of a weaker solution of iodine which contained a small quantity of sodium bicarbonate, and passed his gas at a slower rate, he would find that there was insufficient volatilization to affect the results, and that a condenser to cool the products of combustion was unnecessary, since the solution itself acted in that capacity.

Some elaborate experiments were carried out by the author, when designing the apparatus, on the following important points: The temperature of the products entering the iodine solution; volatility of iodine; depth of seal for complete absorption of SO_2; speed of gas; splitting of gas for effective washing, &c. It was found that there was not sufficient iodine volatilized to colour a starch solution on the outlet of the reaction bottle with less than a cubic foot of gas, which is, on an average, twenty times more gas than is required for a test. But where Herr Niermeyer uses only a little over 70 c.c. of solution containing 10 c.c. N/100 iodine through which he passes gas at the rate of 2½ cubic feet per hour, the author uses 450 c.c. of solution containing 10 c.c. N/100 iodine, and passes gas at the rate of 0·5 cubic foot per hour.

The iodine solution used contains the usual quantity of potassium iodide, as recommended by text-books on volumetric analysis; but it contains in addition about 10 per cent. of glycerine in the N/10 solution, as this has been proved to assist the stability of iodine.

The author agrees that the purification of the air in the laboratory is unnecessary, as the amount of vitiation is not measurable over such a short period as the duration of the test under ordinary conditions.

The question of a rubber cork in the upper end of the combustion tube of the Somerville apparatus is a point which has received a good deal of attention, on account of the liability of getting sulphur vapour from it. It will be remembered that the inlet tube of the reaction bottle protrudes through the cork into the combustion tube; so that the products reach the entrance to the reaction bottle before they could touch the cork, which really forms a dead-end. New and old corks were tried over very large flames; but no increase in sulphur could be detected. There is, of course, no other rubber connection in the apparatus.

The test has been at work in the author's laboratory for nearly two years; and during that time one drawback soon became apparent. It was found that the compartments of an ordinary experimental meter did not entirely free themselves of gas with each revolution; and consequently it was deemed necessary to blow off about a foot of gas, when changing from one quality to another. The manufacturers have got over the difficulty by designing a special little meter, the drum capacity of which is only one-fiftieth of a cubic foot, while one revolution of the dial hand equals five revolutions of the drum. The dial of this meter gives the reading of sulphur in grains per 100 cubic feet direct (so that no calculations or tables are necessary), and it is also divided into parts of a cubic foot if wanted for other purposes. It is very small, very portable, and reads within 2 per cent. of accuracy either way.

STATUTORY GAS LEGISLATION AND MODERN REQUIREMENTS.

By Norton H. Humphrys, Assoc.M.Inst.C.E.

I.

The so-called "Model Acts," which form the basis of special legislation for gas undertakings, are in many respects antiquated, not to say obsolete, so far as modern requirements and conditions of working are concerned. Important departments and additions have come into existence subsequent to, and therefore necessarily unrecognized by, the Acts; while some matters of detail that are recognized and provided for have now passed out of existence. To such an extent is this the case, that the distribution and sale of gas as carried on to-day, though nominally a privileged and protected industry governed by regulations contained in the four walls of an Act of Parliament, are to all intents and purposes as free from such protection as a costermonger's barrow in the street. More than this, it labours under the disadvantage of being hampered and restricted by clauses that savour more of red tape than any practical utility.

Gas undertakings, as a matter of fact, do not enjoy the unrestricted monopoly that was considered to be a special privilege conferred in the form of parliamentary protection, and which was supposed to carry substantial tangible value that warranted an equivalent in the form of obligations and concessions, at the time when the Sales of Gas Act and the Gas-Works Clauses Acts were added to the Statute books. The various provisions relating to price, illuminating power, and purity—presumably inserted in the interests of consumers—are now practically useless and superfluous. Parliamentary protection is of no more value than a will-o'-the-wisp to an undertaking that is otherwise unable to protect itself. What is the reasonable chance of lucrative business at anything approaching the maximum prices of gas authorized, or of a second undertaking being promoted on profitable lines in a district already occupied? What is the use of testing the accuracy of a meter at 5-10ths pressure when it will be submitted in practice to anything between 15-10ths and 50-10ths? Where is the utility of testing gas by an argand or any other form of open burner, when 90 per cent. or more is used in atmospheric burners? What is the use of talking about a minimum of 6-10ths pressure by day and of 8-10ths at night, for the supply of incandescent gas-burners, cookers, geysers, fires, &c., that will not give effective duty under 12-10ths to 15-10ths at the point of ignition? And what gas company would care to take the risk of sending out gas charged with sulphuretted hydrogen, even under the inducement of a substantial premium in place of the statutory penalty? Many other instances could be cited to show that the gas industry to-day is for the most part outside the limits of parliamentary control. It is in the position of an undertaking possessing parliamentary authority in respect to one district, but doing the bulk of its business outside the limits.

This position is the natural result of general progress in the last forty years, and is in no sense a reflection on the authors of the Acts in question, who could not possibly be expected to anticipate history. Having regard to the existing position and state of knowledge at the time, they were not badly or unskilfully drawn, though perhaps a little less of the legal and more of the technical element might be an advantage, as applied to clauses referring to practical operations—such as those dealing with the opening of public thoroughfares for laying mains and services, or testing the quality and purity of gas. On the whole, they were suited to the times, and would be equally suitable now if all things had remained the same. The model form of accounts attached to the 1871 Act has never been seriously challenged, and is universally adopted even by non-statutory gas undertakings, as a means of setting forth the annual accounts; and the fact that it is retained in use in 1911 is an eloquent testimony to the competence of those who originated it.

A searching supervision, involving the repeal of some existing clauses and the insertion of several fresh ones, is necessary before the existing legislation can be said to be in line with modern conditions. But having granted so much, it is a question of mending rather than ending. While there is something that might be struck out, there is much that may be retained, and any changes should be on the lines of amplifying and extending, rather than tending to break the continuity of comparison afforded by past results. The confusion created by adopting new and radically different forms and regulations that could not be compared on even lines with the existing ones, would prove a greater evil than that which it is intended to cure.

The extension and development of the gas industry that have taken place within the last half-century, far exceeds any reasonable forecast or anticipation that could be expected. Some

increase might be looked for from accumulated experience; but the modest expectations held by the leading minds of the time were a striking contrast to the bombast which heralded the introduction of electric light, which was claimed to be capable of scrapping all gas plant as useless old iron in four years. It has had forty years' innings, and so far has done nothing worse than, in a few isolated cases, causing a trifling reduction of dividend for a year or two. Many were willing to suppose that the competition of electricity would about keep things at a standstill. But it was forgotten that the advance of scientific knowledge was not confined to matters electrical. Apart from natural growth and development, the unexpected innovations that have come to the aid of the gas industry may be commended to the attention of those who talk about gas having reached its zenith. Carburetted water gas has been introduced to such extent that there are few, if any, of the larger class of gas-works that do not rely upon its assistance. Machinery has been slowly but surely displacing manual labour, and the gasholder as a distributing motor is assisted and reinforced in the engine-room. The gas engineer of 1860, if subjected to a fifty years' Rip-Van-Winkle experience, would scarcely recognize the gas-works of to-day.

But if there has been advance on the works, what shall be said for the outdoor department? This has sprung up and developed within the memory, and under the care, of many who have not yet retired from active service, and can easily recall the time when there was no outside department really worth the name. The main layer, service layer, and meter-fixer was a small and, to an extent, a temporary addition to the gas-works staff. It was the exception rather than the rule to undertake gas-fitting work, and the general consensus of opinion was not in favour of doing so. But to-day the outside department runs the works very hard, both as to numbers and importance. The man who advises the consumer requires as much skill and training as a working foreman at the gas-works.

The automatic meter, with a cooker and two or three lighting points provided by, and under the control of, the gas company, is now a power in the land. And it flourishes in the open, outside the glass-house of parliamentary protection. The general wording of the Model Acts authorizes the supply of apparatus to be used for the consumption of gas on hire or other mutually agreed terms; but there is nothing that anticipates the fact that we have before us at the present time as many customers who are fitted complete up to the burner by the company as there are who supply and own the fittings. And the success that has attended the slot-meter system—a success, it should be observed, that is due more to the supply of fittings free of first cost than to any attraction attaching to the penny-in-the-slot system—is sufficient to warrant the expectation that in another twenty years it will be the rule for all consumers to be fitted throughout by the company. It is just as easy to put a quarterly customer on inclusive terms as a prepayment one. If the price of gas is 3s., and the addition to cover the cost of fittings 9d., it is as easy to render a quarterly account priced out at 3s. 9d. per 1000 cubic feet, as to adjust a slot-meter to the required rate.

Another unexpected innovation was the Welsbach burner, which was regarded as a practical impossibility for some years, but has now taken up by a long reach the foremost place as a gas lighting medium. We could trace the numerous advances that have been made, including high-pressure and both inverted or reflex lights. Maintenance of incandescent burners by the gas company is a regular thing, and it is not unusual to find nearly as many men exclusively engaged on maintenance as are employed in the retort-house. The consequence of all this, together with improvements in cookers and heaters, resulting in almost as great an increase of practical duty per cubic foot of gas consumed as has been assured in regard to lighting, is that 80 to 90 per cent. of the gas used in Great Britain passes to its consumption through an atmospheric burner. Free maintenance is being talked about, which if adopted would mean the universal adoption of the atmospheric burner.

While there are plenty of regulations for the protection of the flat-flame user both in respect to quality and price, there is nothing of the kind for the atmospheric burner or the slot-meter. There is a general impression to the effect that the photometer is a very indirect indicator of the value of gas to the user of the incandescent burner, and that the calorimeter is more suitable; but the latter has not yet obtained the position of a legal standard. A great deal was made in the earlier days about the advantage that the consumer secured by a maximum price. But that there is such a thing as this has been forgotten for years; and it is doubtful if there could be found, throughout the length and breadth of the land, a gas company charging and selling at anything close to the maximum. But there is no limit for the slot consumer. The company can put on a loading of 9d., 1s., 1s. 3d., or whatever they like without fear of being brought to book by Act of Parliament. If the limitations of price are necessary, how is it that gas companies have not taken full advantage of their absence to plunder the slot-meter consumer? So far from suffering through the lack of parliamentary assistance, these important departments appear to do better without it.

For some reason or other that is not very obvious, there seems to have always been an impression on the part of the powers that be, that the user of gas required far more stringent protection than the purchaser of other commodities. We naturally claim a high position for gas among the necessaries of modern existence, but do not go so far as to say it is really more important, as regards public health or the pocket, than any other. There are other commodities—such as the vital necessaries of life—in more extensive demand, and that might be expected to be of more importance; but if we search the adulteration Acts from A to *Z*, we shall find nothing approaching the stringency of the quality and purity clauses relating to coal gas. The purchaser of candles, oil, petroleum, or electricity has no similar guarantee as to the quality or purity of his supply; and it is difficult to see why if such regulations are necessary for one they should not be equally so for the others. The fact is that the clauses referring to price, pressure, purity, and illuminating power are a dead-letter to 90 per cent. of the users. The varied experiences above cited are proofs that the penalties carried by these clauses are absolutely useless and superfluous. So long as gas was produced by one identical process, and enjoyed to some extent a monopoly, there was no positive objection to them. But this does not apply under the conditions that obtain to-day; and in the interests of both parties they are actively objectionable, as cramping the development of business and hindering the company from supplying the real need, which is not necessarily measured by the photometer or calorimeter. It is the best possible value in return for the cash paid. A company may be in a position to supply 10-candle 500 B.Th.U. gas at 1s. 6d. per 1000 cubic feet, but under the provisions of their Act be compelled to supply 14-candle 600 B.Th.U. gas, although it cannot be sold for less than 3s.

LONDON AND SOUTHERN JUNIOR ASSOCIATION.

Visit to the Gas-Meter Company's Works.

Arrangements had been made for a visit last Saturday afternoon of members of the London and Southern District Junior Gas Association to the Kingsland Road works of the Gas-Meter Company, Limited; and at the hour appointed, there was a very satisfactory muster. The inspection which followed proved highly interesting; and the visit altogether was greatly enjoyed—the members being in the good hands of the Company's Secretary (Mr. F. W. Church), the Manager (Mr. Thomas Wilkins), the Works Manager (Mr. John Gow), and other members of the staff.

A walk through the works reveals the certain signs of long continued expansion of business; for there are on all sides evidences of the additions and extensions that have from time to time been necessitated by the demand for more and yet more working space. The business carried on by the Gas-Meter Company is, as is well known, an old established one. In fact, it was taken over in the year 1862 from Messrs. Croll, Rait, and Co., with regard to whose factory the following particulars appeared in the "Illustrated London News" for March 5, 1859: "The new gas-meter factory of Messrs. Croll, Rait, and Co., in the Kingsland Road, was opened a short time ago under the auspices of the Right Honourable the Lord Mayor. After inspecting the building, the Lord Mayor visited the lower fitting room, which was handsomely decorated with evergreens, artificial flowers, flags, and banners for the occasion, and in which an excellent dinner was laid out upon tables extending the whole length of the spacious apartment on both sides, with a cross table at the head. Here his Lordship addressed the assembled workmen and their wives in a speech of considerable length, dealing with the origin, progress, present position, and future prospects of the manufacture of gas. After dinner, the room was cleared for a dance; and the festivities were kept up to a late hour." In a paper submitted many years ago to the members of the Society of Arts by Mr. Alexander Angus Croll, it was mentioned that Mr. Croll and Mr. Richards patented their original dry meter in 1844; and this is the meter, with improvements, which the Gas-Meter Company now manufacture.

They do not, however, confine themselves entirely to the dry ordinary meter; for something (though not very much) is also done in the wet type, and large numbers of prepayment meters are turned out in accordance with Mr. Gow's patents. Of the latter, there have been two patterns. The first, which was brought out nearly twenty years ago, had the prepayment mechanism attached to the front of the case; but later on this was superseded by a side attachment, to meet the requirements of gas undertakings who desired meters of less depth. In addition, of course, the firm have for many years made Valon's patent stop meter; and now Mr. Gow has a patent meter for use on high-pressure services, fitted with two indexes. The ordinary index is closed in; and the compensating index is visible to the consumer. The latter index is arranged for any particular pressure of gas required; the changing of two wheels being all that is necessary to adapt the compensating arrangement to any desired pressure. During the last few months the Company have, it is pleasing to note, been exceptionally busy; no less than about 20,000 meters having been put in hand since July.

The factory at the present time occupies two large buildings, which are connected by bridges; and some idea of the extent of the operations carried on will be gathered from the itinerary prepared for the party: Stamping shop; dry proving room and engine house; lower tin shop; middle new tin shop; top tin shop; brass shop; stores; leather room; old top shop; finishing and paint shops; meter stores. It should, however, here be mentioned that all the heavy work connected with the business is

done at the Company's Oldham branch (where station meters up to 300,000 cubic feet per hour capacity have been made). Only hand stamping is in practice in the Kingsland Road stamping room; but there are to be seen there a number of labour-saving machines of various kinds. There are extensive meter stores and tin plate stores; the meters always in stock ranging from 1-light to 600-light in size. In the blacksmiths' shop, two or three men are occupied in doing odd jobs for different parts of the works. In the dry-meter testing shop (there is also a separate one for wet meters) there are fixed fourteen test holders and two sounding holders; and it was possible for the members to get an insight into the scientific testing of meters. In fact, it was a great advantage that they were able to see the works generally in operation. The sounding meters are for detecting leaks; but there are also leak indicators in use. At one time the meters were tested for leakage at 3 inches pressure; but since the advent of water gas and higher pressures, it has been made a rule not to send meters out until they have been tested under a pressure of 12 inches. An interesting point gathered in this shop was in connection with the tinmen's stoves, which are heated, under high pressure, by gas—in some cases the supply being with the air compressed, and in others with the gas under pressure. Mr. Gow has found that to compress the air is the more economical plan—indeed, it is his experience that, when the gas is under compression, the consumption of gas is 4 or 5 cubic feet more per hour than by compressing the air. The factory, it may here be remarked, is excellently lighted by high-pressure gas. For compressing the gas, an installation of Tilley's compressors is operated by a Gardner gas-engine; while for the compressing of the air, a National gas-engine is employed—separate supplies of air being sent to the tinmen's shop and to the proving room—where the meters are tested first with gas and then with air. It is to be seen that the meters for the gas-engines have on them an intimation that they are without back-stop; and Mr. Gow explains that it is found beneficial to so arrange meters that are required for gas-engine purposes, inasmuch as, in case of a back-pressure, it might cause the mechanism to throw-back up against the back-stop, and so break down the meter. He has never experienced any failures since doing away with the back-stop in engine meters; and he has made them of all sizes—and extra strong.

One is struck by the large number of meters under repair in the various shops devoted to this work, as well as the number of new parts being made. In fact, it is stated that, to keep the factory in full swing continuously, about 2000 new meters have to be under construction. In the brass shop there are some interesting wheel-cutting machines, and another ingenious appliance invented for the special purpose of marking the numbers on the circular plates which are employed in the prepayment meter mechanism. There are commodious stores for the different meter-parts; and an important department of the factory is the leather room, where all the leathers are examined by gaslight, so that any possible source of leakage may be detected. The best Persian sheepskins are employed; for nothing satisfactory has been found to take their place. Capacious finishing shops are necessary, on account of the large amount of assembling of parts that has to be done. It is explained that a considerable part of the expense incurred in meter-making is due to the great care that has to be exercised in connection with the assembling. A point noted is that the best Berlin wool is used by the Company for stuffing, because of its elastic nature, which is more pronounced than is that of cotton. In the white metal shop there is to be seen the operation of casting different small parts of meters.

Passing through the offices, attention is attracted to the large dry meter in glass case, for which the Company were awarded a gold medal at the Paris Exhibition of 1867, and which was also shown at the Earl's Court Gas Exhibition. Among a number of framed photographs of pioneers of the great gas industry, too, there is one of a 35,000 cubic feet per hour round station meter, leaving the firm's Oldham works for shipment to South America. This is stated to be the largest sized meter that can be sent complete by railway; the weight being about 8¼ tons. Some customers, it is learnt, have been on the books ever since the business was started. And it may be remarked that in connection with the management also there are long records—both Mr. Wilkins and Mr. Gow having been with the firm for nearly half-a-century. As for Mr. Church, his ancestors have been in the gas profession from the very first. His grandfather, Mr. Jabez Church, Gas Engineer, of Colchester, took out a patent in 1847 for his invention of improvements in the manufacture of coke, and in ovens for producing it.

At the conclusion of the inspection, the party (about 80) were entertained by the Company at a meat tea, following which

Mr. J. G. Clark (the President of the Association) remarked that a meter works was of much interest to the members. In going round the factory that afternoon, what struck him was the great amount of attention that had been paid to details in the manufacture of the gas-meter. There were over a hundred parts; and every one of these had to be correctly made and accurately placed. It would be useless for them to manufacture gas if they had not the appliances by means of which they could measure and use it. The great strides of the gas industry depended now, and had depended in the past, upon the hearty co-operation of all the branches concerned.

Mr. S. A. Carpenter (the Junior Vice-President) proposed a hearty vote of thanks to the Company for their kindness in allowing the members to inspect the works, and for their hospitality and he coupled with the vote the names of Mr. Church and Mr. Wilkins. He pointed out that Saturday afternoon visits were a great convenience to the Association, and they much appreciated the fact that the factory had been kept in full working order specially for their inspection. Everyone had taken the greatest pains to give all information that was desired. The Company had shown the Association how up-to-date they were—he was thinking more particularly of the high-pressure meter. When high-pressure gas first came into use, people wondered whether it would be possible to have meters to measure it. When attempts were made to provide them, many difficulties were encountered, owing to the gas escaping from the glands, &c. The compensating index for high-pressure meters which they had seen that day was a very ingenious arrangement.

Mr. E. G. Stewart having seconded the proposition,

Mr. W. J. Liberty, in supporting it, made a long and interesting statement, in which he gave the members many particulars with regard to the early history of gas supply in London, and the life and work of Mr. Croll, as well as a description of the dry gas-meter. In the course of his remarks, he pointed out that the name of Croll, the originator of the works the members had just inspected, was a prominent one in the gas industry. Sheriff of London and Middlesex in 1852, Alexander Angus Croll took a citizen's interest in matters pertaining to the general welfare. About 1848, when there was an agitation in London against dear gas, Mr. Charles Pearson, the City Solicitor, in the course of a report on the subject, stated that the cost of gas should be governed by the expense of distribution, and not of manufacture. Co-operating with him was Mr. Croll; and, in spite of opposition, they started the Great Central Gas Consumers' Company. Inducements were offered to consumers in the shape of free meters and service-pipes; and gas was supplied at 4s. per 1000 cubic feet, with a stipulation that the rate should be reduced to 3s. in the event of 10 per cent. dividend being paid. The Company, however, needless to say, never got below the 4s. The works, of which Croll was the Constructional Engineer and Manager, were situated at Bow, and were absorbed by the Gaslight and Coke Company in 1870—becoming their Bow Common station. During the period of unrestricted gas competition in London, the "cheap gas" agitation spread south of the Thames; Croll and John Thwaites (afterwards Sir John Thwaites, the first Chairman of the Metropolitan Board of Works) being the prime movers. The outcome of the agitation was the starting in South London by these gentlemen of the Surrey Consumers' Gas Company. This Company also promised to supply gas at the rate of 4s. per 1000 cubic feet; and shortly afterwards the price fell to this figure all over London. Croll took a seven years' lease of the Company, and worked it; occupying the position of Engineer during this period. In his early life, Croll was connected with the watch-making industry; and it was, perhaps, this early training which caused him to turn his attention to the production of a dry meter for measuring gas. In conjunction with William Richards, he invented the dry meter; the date of the patent being 1844. Croll was also a Director of the Tottenham Gas Company, a successful lessee of the Coventry Gas Company, and Consulting Engineer to the Winchester Gas Company; while he also did yeoman service for the Jersey and Guernsey Gas Company in its early days, and was Consulting Engineer and Agent in this country to the Shanghai Gas Company up to 1870. To give an idea of the versatile character of the man, he might point out that he designed and had built the great Wool Exchange and offices adjoining the Guildhall in the City of London, on the site of the administrative department of the old Central Consumers' Gas Company. As to the Gas-Meter Company, he might mention that during the five years ending Dec. 31, 1910, their average output had been 40,000 meters per annum. Mr. Wilkins, he concluded, had been intimately associated with Mr. Croll.

The vote having been carried with applause,

Mr. F. W. Church thanked the members, and said it was a great pleasure to see them there. When Mr. Liberty approached him on the subject of the visit, he felt proud that his Company had been selected as one of the firms which were regarded as worthy of consideration. He hoped that, in going through the works, the members had not been disappointed. He wished them all "A Happy Christmas and a Prosperous New Year."

Mr. T. Wilkins, who also acknowledged the vote, said, though he could not go back over the whole period covered by Mr. Liberty in his statement, he could confirm the greater portion of what he had told them. He (Mr. Wilkins) was connected with Mr. Croll nearly fifty years ago, and knew him as one of the hardest workers of his day. Croll and the men who worked with him did yeoman service for the London gas industry of that time. When the matter of inviting the Association to the works was mentioned by Mr. Church to the Board, the Directors said "By all means." As for himself, he regarded the members in some way as "his boys;" for one of his sons was connected with the Association before he went to take charge of the Godalming Gas-Works. He hoped at some future time to welcome them there again, when they had something new to show them. Meanwhile, if any of them should happen to find themselves in Oldham, and would go to the Company's works there, they would see one of the finest gas-meter factories in the kingdom. They did all the large work at Oldham; and Mr. W. A. Nash, the Assistant Manager there (who was present that day), would give them a hearty welcome.

PUBLIC LIGHTING OF THE CITY OF LONDON.

A Review of the Subject.

As recorded elsewhere, the Corporation of London came to a decision last Thursday in Common Council, with respect to its public lighting, after experimenting, we were going to say, for six years. We should not be regarded as incorrect if we named a far longer period; for the Corporation have been experimenting practically ever since the period when three competing gas companies were at one and the same time within its borders. At any rate, the City of London has always been in the forefront in matters concerning public lighting, and has experimented with every form of illuminant and the latest type of lamp.

It is on record that in 1861 the Corporation and the late City Engineer (Colonel Haywood) experimented extensively with the "carburation of gas" as supplied to the public lamps, by the process of the United Kingdom Carburating Gas Company—a patent for placing near to the gas-burners a receptacle containing coal naphtha, and the gas passing through or over this taking up, and becoming enriched by, the addition of volatile hydrocarbons in the naphtha, and the illuminating power of the gas being increased from 25 to 77 per cent. This naphthalization of the gas saved £1 per lamp per annum.

In 1878, Mr. Deputy Basingham (the Chairman of the late Commissioners of Sewers) and Colonel Haywood brought over from Paris the Jablochkoff lamps as installed in the Avenue de l'Opéra by the Société Générale d'Electricité; sixteen lamps being erected on Holborn Viaduct, displacing some 86 gas-lamps. They only remained in lighting about three months; owing to the increased cost over the displaced gas-lamps. In 1879, further experiments were made in Queen Victoria Street with Sugg's "London" argand governor burners. In 1880, the City Commissioners again experimented in Cheapside, in Ludgate Hill, and in King William Street, with lamps lighted by the Brush Company, Messrs. Siemens and Co., and the Electric Light and Power Construction Company. In 1882, the Brush Company and the Edison-Swan Company further experimented on the Holborn Viaduct; the Anglo-Brush Electric Company lighting New Bridge Street and Ludgate Hill until 1885. In the meantime, further experiments had been made by Messrs. F. Siemens Patent Gas-Light Company in 1881-3 with regenerative gas-burners, and in the latter year with Messrs. Sugg and Co.'s groups of flat-flame gas-burners. During this year, Mr. (now Sir) W. H. Preece, the Engineer to the General Post Office, reporting on the electric light experiments, stated that though the streets of London were fairly lighted by gas, it had been proved by both the gas and electrical interests that the illumination could be very materially improved; and his opinion was that for street illumination all the conditions could be obtained by gas as by electricity. In 1889, oil being cheap, the Commissioners permitted the Defries Oil Light Company to instal oil-lamps on the Holborn Viaduct; but nothing came of it. After some thirteen or fourteen years of further experiments, the Brush Company and the Laing, Wharton, and Down Company obtained contracts for lighting the City; and the main thoroughfares were lighted by arc lamps by the end of 1893. The two Companies were afterwards absorbed by the City of London Electric Light Company, who installed 500 open arc lamps.

The advent of Welsbach's incandescent mantle, the introduction of the flame arc lamp, and the bringing on to the market of high-pressure gas-lamps, have caused endless experiments in the City during the last ten years. First one thoroughfare and then another was given over to the newest form of illumination—old lamps being partly displaced; so that the City was at one and the same time both the "Mecca" and the derision of those interested in street illumination, However, in July, 1909, the Corporation decided to send a deputation of their Streets Committee to the Continent. They were fortunate in having among their number Mr. Josiah Gunton, the present Chairman of the Committee, who has remained in the chair beyond the usual time, and worked, in season and out of season, upon the question of the improvement of the public lighting of the City. Following on the deputation's return, further experiments were made in Cannon Street with centrally hung high-pressure gas-lamps with lowering gear and high-pressure gas-lamps upon columns in New Bridge Street. The eastern end of Cheapside and the Poultry were fitted up with low-pressure gas-lamps on long brackets over the footpaths; the Electric Light Company installing some centrally-hung lamps at the western end of Cheapside and Watling Street, and 4000-candle power flame arc lamps on posts in Farringdon Street, while Paternoster Row has been lighted with 75-candle metallic filament lamps on brackets. The experiments have been running now for a year; and, after much careful consideration, the Streets Committee presented to the Common Council a unanimous report in the following terms:

> On the references of Oct. 21, 1909, and Feb. 17, 1910, as to lighting the streets of the City; submitting a scheme for lighting in about equal proportions by gas and electricity, in accordance with plan, by means of centrally-hung lamps as far as practicable, for a period of ten years, whereby an annual saving of about £6800 will be effected, and an increase in illuminating power obtained of about 600,000-candle power; and recommending that the Gaslight and Coke Company and the City of London Electric Lighting Company, Limited, be permitted to light the public ways in accordance with the said scheme, and that the Committee be authorized to carry out the arrangements, with power to settle all necessary details.

From the figures given on pp. 680-2, it might seem, on the first blush, as though the terms were not at all equal, as the City Electric Company are supplying 892,400-candle power against their old illuminating power of 391,510 candles for £7322, while the Gaslight and Coke Company give a new illuminating power of 377,500 candles (the old candle power being 276,895) for £6719. There is very little difference in the money total received; but a considerable difference in the candle power each Company will give. This needs some explanation, or it might be inferred that "light for light, electricity is cheaper than gas." It is explained in the following manner: From a perusal of the Committee's report, it will be seen that the areas of the two Companies will remain very much as at present. The area of the City is only about one mile square, with 56 miles of streets, about 12 miles of which are main thoroughfares. At present the Electric Light Company, with some few exceptions, light the whole of the main thoroughfares; the Gaslight and Coke Company lighting the remainder of the streets and roads. In the main thoroughfares, the electric lamps will be less than 500 in number, of 4000, 3000, and 2000 candle power each. A glance at the list of roads to be thus lighted will show that Cheapside and the Poultry are to be lighted by sixteen 3000-candle power arcs and two or three smaller lamps—giving a total illumination of 50,600 candles for this one thoroughfare, while the Gas Company's small lamps of 90-candle power will run into a total of four figures. Therefore, to get an equivalent 50,600-candle power illumination to that in Cheapside, they will be compelled to erect some 562 columns or brackets, supply lanterns and fittings, and open the ground and lay on 562 services, and also maintain them, against the 20 points supplied by the Electricity Company. Taking the annual cost of the 4000-candle power flame arc lamps at something in the neighbourhood of £20, and the 90-candle power inverted gas-lamps at something under £3 per annum, the annual charge not being disclosed, the cost to the Corporation, owing to capital outlay by the Gas Company, on the 562 columns or brackets, lanterns, fixings, and new services, would be about £1686 per annum, at £3 per point for the 50,600-candle power illumination, but giving the Company 562 units to maintain, against 20 by the Electric Light Company. Another way of stating it would be that to get the same illumination the Gas Company would have to open and lay on 444 services, provide columns (or brackets), lanterns, and fittings, and maintain them in the side streets to equal one 4000-candle power lamp of the Electric Company in the main road. The Gas Company have about 44 miles of side streets, and some 1½ miles of main roads to light for £6719 per annum, against about 10½ miles of main thoroughfares by the Electric Light Company for £7322 per annum.

Having disposed of this matter, it only remains to select the principal points in the speech of the Chairman of the Streets Committee when introducing the report to the Court of Common Council on Thursday. He commenced by stating that he occupied a unique position in recommending the acceptance of a contract that entailed no extra charge upon the Corporation, but effected a saving to the City of from £6000 to £7000 per annum, while the increased illumination gained would be about 600,000-candle power, or double that at present enjoyed. This may be best shown in tabulated form as follows—

Present Cost.

Gas	£10,099 0 0	
Electricity	10,774 10 0	
		£20,873 10 0

Future Cost.

Gas	£6,719 0 0	
Electricity	7,322 17 6	
		14,041 17 6
Saving		£6,831 12 6

Present Illuminating Power.

	Candles.	Candles.
Gas	276,895	
Electric	391,510	
		668,405

Future Illuminating Power.

	Candles.	
Gas	377,760	
Electric	892,400	
		1,270,160
Total increase		601,755

The next important remark was that, "the saving in money was not the main object in starting out," but that the Committee had endeavoured to make the largest saving commensurate with efficiency in lighting. The Chairman went on to say that during their visit to such important cities as Berlin, Brussels, Vienna, &c., they found every one of them lighted better than the City of London. The experiments carried out in the City had given entire satisfaction; the centrally-hung lamps having been highly appreciated. Neither of the two Companies concerned would agree to light the whole of the City. Had they so agreed, it would have been necessary to lay high-pressure gas-mains throughout the principal thoroughfares, and so disturb all the roads. On the question of the safety of the centrally-hung lamp system, the Chairman said that during the visit of the deputation to the Continent they found that there had been only one

[*Continued on p.* 682.]

THE IMPROVED LIGHTING OF THE CITY OF LONDON.

SCHEME OF THE GASLIGHT AND COKE COMPANY.

Thoroughfare.	Approximate Length in Yards.	Approximate Width in Feet.	Existing				Proposed			
			How Lighted.	Number and Size of Lamps.	Description of Fixing.	Estimated Total Candle Power.	Candle Power of Burner.	Number of Lamps.	Description of Fixing.	Total Candle Power.
Mansion House Street and Royal Exchange area	130	90	Gas (10 in.)	1 100 ft. 2 30 ft.	Column ,,	5,400	3,000 (2 ventilating lamps) 1,500	1 2	Rests ,,	6,000*
New Bridge Street	233	70	Electric	1 Flame 5 Open	,,	5,250	2,000 300	6 1	Post ,,	12,300
Arthur Street East	40	60	Gas (10 in.)	2 10 ft.	,,	600	2,000	1	Centrally hung	2,000
Cannon Street	524	60	Electric and gas	5 Flame 7 Open 1 8½	Centrally hung Column ,,	15,380	2,000 2,000	12 2	,, Column	28,000
Chancery Lane	100	38	Gas	2 4½ 1 1500 c.p.	Column & bracket	1,630	2,000 90	1 2	Bracket ,,	2,180
Fleet Street	557	60	H.P. Gas	16 1500 c.p.	Bracket & column	24,000	2,000 2,000	12 4	Centrally hung Column	32,000
Lower Thames Street (part)	230	60 35	Gas (10 in.)	1 30 ft. 16 10 ft.	Column Column & bracket	5,700	2,000 2,000	6 1	Centrally hung Column	14,000
Monument Street	133	50	Gas	1 4½ 16 10 ft.	Bracket ,,	4,865	2,000	3	Centrally hung	6,000
Queen Street (Queen Victoria Street to Cheapside)	143	48 to 70	Gas (10 in.)	4 20 ft.	Column	2,400	2,000	3	,,	6,000
Queen Victoria Street	1067	70	Gas (10 in.)	4 10 ft. 38 20 ft.	,, ,,	25,200	2,000	42	Columns	84,000*
Salisbury Square	30	95	Gas	2 (1 4½ 1 21¼)	Column & bracket	390	2,000 90	1 1	Column Bracket	2,090*
Fish Street Hill	147	35	,,	5 4½	Bracket	325	1,000	3	Centrally hung	3,000
Falcoln Square	45	70	,,	4 (1 30 3 4½)	Column & bracket	1,095	1,000 180	1 2	Column Bracket	1,360
Golden Lane	126	50	Gas and Electric	5 4½ 1 Open	Column ,,	1,075	1,000	2	Centrally hung	2,000
Gracechurch Street	(2 Ventilating gas columns as will be arranged over convenience)									
Lombard Street (part) by Church	—	—	Gas	1 66 ft. 1 20	Columns	2,600	2,000	2	Columns	4,000
Monument Square	33	100	Gas (10 in.)	4 10 ft.	Bracket	1,200	300	4	Brackets	1,200
St. James Place	37	100	Gas	4 4½	,,	260	750 90	1 3	Brackets & columns	1,020
America Square	46	100	Gas	1 8½ 5 4½	Column & bracket	455	240 90	3 1	Columns	810
Charterhouse Street	488	60	,,	18 4½	Column & bracket	1,170	300 240	1 11	,,	2,940
Finsbury Circus	347	65	,,	6 8½ 22 4½	Column	2,210	240	12	,,	2,880
Mansell Street	130	50	,,	6 4½	Column & bracket	390	240	4	Brackets & columns	960
Trinity Square	100	60	,,	6 4½	Column	390	240	3	,,	720
Angel Street	87	48	,,	4 4½	,,	260	180	3	,,	540
Bream's Buildings	60	30	,,	3 4½	,,	195	180	2	Columns	360
Bouverie Street	187	30	,,	8 4½	Bracket	520	180	5	Brackets	900
Broadway	36	30	,,	2 4½	,,	130	180	2	Columns & brackets	360
Crutched Friars	247	35	,,	11 4½	,,	655	180	8	,,	1,440
Carmelite Street	160	42	,,	8 4½	Column	520	180	5	,,	900
Cripplegate Bnildings	40	40	,,	2 4½	,,	130	180	1	,,	180
Church Passage	67	40	,,	1 8½ 2 4½	Bracket	260	90 180	2 1	,,	360
Crosby Square	60	60	,,	3 4½	Column & bracket	195	180 90	2 1	,,	450
Dowgate Hill	133	45	,,	5 4½	Column & bracket	325	180	3	,,	540
Farringdon Avenue	140	40	,,	4 4½	Column	260	180	3	,,	540
Fetter Lane	427	30	,,	22 4½	Bracket & column	1,430	180	12	,,	2,160
Falcon Street	70	38	,,	2 4½	Bracket	130	180	1	,,	180
Hart Street	57	35	,,	4 4½	,,	260	180	1	,,	180
John Carpenter Street	163	42	,,	10 4½	Column	650	180	5	,,	900
John Street	133	45	,,	9 4½	Column & bracket	585	180	3	,,	540
Jewry Street	160	38	,,	7 4½	Bracket	455	180	4	,,	720
Circus—Minories	17	50	,,	1 8½	Column	130	180	1	,,	180
Crescent	50	60	,,	1 8½ 3 4½	,,	325	180	4	,,	720
Lime Street	277	25	,,	13 4½	Bracket	845	180	8	,,	1,440
Little Britain	337	22 to 40	,,	17 4½	Column & bracket	1,105	180 90	5 6	,,	1,440
Bartholomew's Close	366	20 & 100	,,	25 4½	,,	1,625	180 240 90	5 1 12	,,	2,220
King Edward Street	180	60	,,	8 7 1 10½	,,	1,680	180 240	8 1	,,	1,680
Gt. Tower Hill	130	15 Ftwy	,,	8 4½	Bracket	520	180	6	,,	1,080
London Bridge Steps	—	—	,,	6 8½	,,	780	180	6	,,	1,080
London Wall—part	280	20 to 30	,,	12 4½	Column & bracket	780	180	9	,,	1,620
Mark Lane	260	35	,,	15 4½	Bracket	975	180	8	,,	1,440
Milk Street	160	30	,,	5 4½	,,	325	180	6	,,	1,080
Mincing Lane	167	25	,,	10 4½	,,	650	180	5	,,	900
Moorfields	210	35	,,	9 4½	Column & bracket	585	180	5	,,	900
Old Jewry	140	20 to 40	,,	6 4½	Bracket	390	90 180	2 4	,,	900
Royal Mint Street	120	35	,,	5 4½	,,	325	180	4	,,	720
Stonecutter Street	75	40	,,	3 4½	Column & bracket	195	180	2	,,	360
Tallis Street	103	40	,,	6 4½	Column	390	180	2	Column	360
Temple Avenue	160	42	,,	8 4½	,,	520	180	4	,,	720
Tudor Street	207	40	,,	13 4½	Column & bracket	845	180	8	Column & bracket	1,440
Whitecross Street	250	40	,,	12 4½	Brackets	780	180	7	Brackets	1,260
William Street	70	35	,,	3 4½	,,	195	180	1	,,	180
Wood Street	467	30	,,	16 4½	,,	1,040	180	14	,,	2,520
Various Streets	Various	—	,,	2158	Bracket & column	141,910	90	1485	,,	133,650

* Subject to revision.

NOTES.

All thoroughfares not enumerated in the foregoing list of streets are to be lighted with one-burner low-pressure inverted lamps of 50-candle power, in lieu of upright burners 65-candle power.

All new gas-lamps will be of the "Inverted" burner type.

The "existing" lighting is taken as previous to last year's experiments.

The number of the different unit lamps will be subject to adjustment as may be found necessary when dealing with each area or street in detail.

The total annual cost of the existing gas lighting amounts to about £10,099, while the cost of the new lighting will be about £6719 per annum.

SCHEME OF THE CITY OF LONDON ELECTRIC LIGHTING COMPANY.

Thoroughfare.	Approximate Length in Yards.	Approximate Width in Feet	Existing. How Lighted.	Existing. Number and Size of Lamps.	Existing. Description of Fixing.	Existing. Estimated Total Candle Power.	Proposed. Candle Power of Burner.	Proposed. Number of Lamps.	Proposed. Description of Fixing.	Proposed. Total Candle Power.
Farringdon Street	490	100	Electric and gas	16 Enclosed Arcs; 2 (1 60 ft., 1 4¼)	Column	9,865	4,000	7	Central posts	29,675
							200	4	,, ,,	
							200	4	Centrally hung	
							75	1	Bracket	
Holborn (including the Circus)	307	95	Electric and gas	8 Flame Arcs; 1 8½; 4 4¼	,,	12,390	4,000	6	Central posts	26,300
							2,000	1	Posts	
							75	4	,,	
Ludgate Circus	42	150	Electric and gas	2 Flame Arcs 600 c.p.; 4 h.p.	,,	5,400	4,000	2	Central posts	8,000
Mansion House Street and Royal Exchange Area	130	90	Electric	1 Flame; 1 Open	,,	2,250	2,000	2	Posts	4,000
Aldgate High Street	333	50 to 80	Electric	8 Open Arcs	,,	6,000	2,000	4	Central posts	14,000
							2,000	3	Centrally hung	
Bishopsgate Street Without	600	80	Electric and gas	11 Open; 6 (5 8½; 1 4¼)	,,	8,965	2,000	5	,, ,,	24,500
							2,000	7	Posts	
							100	5	Rests	
Blackfriars Bridge Approach	73	170	Electric	3 Flame; 1 Filament	,,	4,800	2,000	3	Central Posts	6,300
							300	1	Rest	
Finsbury Pavement	243	70	,,	6 Open	,,	4,500	2,000	5	Centrally hung	10,100
							100	1	Rest	
Holborn Viaduct	407	80	,,	9 Flame; 14 Open	,,	13,500	2,000	2	Central Posts	20,000
							2,000	8	Centrally hung	
Aldersgate Street	757	50	Electric and gas	1 Flame; 4 (1 60; 2 12¾; 1 8½)	,,	14,320	2,000	12	,, ,,	32,400
							2,000	4	Rests	
							100	4	,,	
Cannon Street (Western End	266	60	Electric	5 Flame	Centrally hung	10,000	3,000	5	Centrally hung	15,000
Bishopsgate Street Within	373	60	Electric	10 Open	Column	7,500	2,000	9	Centrally hung	18,000
Blomfield Street	180	40	Electric and gas	2 ,, 2 8½	,,	1,760	2,000	2	Centrally hung	8,200
							2,000	2	and Post	
							100	2	Rests	
Cheapside and Poultry	587	60	Electric and gas	13 Open; 1 Flame; 2 8½	,,	11,510	3,000	16*	Centrally hung	*50,600
							2,000	1	Post	
							200	3	Rests	
Circus Place	27	70	Electric	1 Open	,,	750	200	1	Rest	200
Cornhill	307	50	,,	7 ,,	,,	5,250	2,000	5	Centrally hung	12,000
							2,000	1	Post	
							2,000	1	,,	
Eastcheap	240	65	,,	5 ,,	,,	3,750	2,000	4	Centrally hung	10,200
							100	2	Rests	
Eldon Street	167	45	,,	4 ,,	,,	3,000	2,000	3	Centrally hung	6,000
Fenchurch Street	600	50	Electric and gas	12 ,, 2 4¼	,,	9,130	2,000	12	,,	24,000
Giltspur Street	137	55	Electric	2 Open	,,	1,500	2,000	2	,,	4,000
Gracechurch Street	360	50	,,	9 ,, 1 Flame	,,	8,250	2,000	6	,,	14,000
							2,000	1	Post	
Great Tower Street	476	35 to 65	,,	10 Open	,,	7,500	2,000	8	Centrally hung	16,000
King Street, Cheapside	150	35	,,	2 ,,	Bracket	1,500	2,000	2	,,	4,000
King Street, Smithfield	213	40 to 100	Electric and gas	3 ,, 2 (1 8½; 1 4¼)	Column & bracket	2,445	2,000	3	Posts	6,100
							100	1	Rest	
King William Street	467	50	Electric and gas	12 Open; 1 4¼	Column	9,065	2,000	6	Centrally hung	20,000
							2,000	4	Posts	
Leadenhall Street	473	50	Electric	10 Open	,,	7,500	2,000	8	Centrally hung	16,000
Liverpool Street	246	65	Electric and gas	6 ,, 1 60 2 8½	,,	6,560	2,000	8	Posts	16,000
Long Lane	280	55	Electric	5 Open	,,	3,750	2,000	2	Centrally hung	8,000
							2,000	2	Posts	
London Wall (part)	447	40	Electric	8 Open	Column	6,000	2,000	7	Centrally hung	14,300
							75	4	Rests	
Lower Thames Street (part)	350	60 & 35	Electric	7 Open	Bracket	5,250	2,000	7	Centrally hung	14,000
Ludgate Hill	277	60	Electric	7 Flame	Column	10,500	2,000	5	,,	14,150
							2,000	2	Rests	
							75	2	,,	
Minories	487	50	Electric and gas	11 Open; 1 4¼	,,	8,315	2,000	10	Centrally hung	22,000
							2,000	1	Bracket	
Moorgate Street	290	60	Electric and gas	6 Open; 2 8½	,,	4,760	2,000	7	Centrally hung	14,200
							100	2	Rests	
New Broad Street (part)	123	40	Electric	3 Open	,,	2,250	2,000	3	Centrally hung	6,000
Newgate Street	353	50	Electric and gas	1 Flame; 7 Open; 1 8½	,,	6,880	2,000	2	Rests	16,000
							2,000	6	Centrally hung	
Old Broad Street	260	40	Electric	7 Open	Column & bracket	5,250	2,000	7	,,	14,000
Princes Street	177	50	,,	4 Open	Column	3,000	2,000	1	Post	8,000
							2,000	3	Centrally hung	
Queen Street (from Bridge to Cannon Street)	457	48 to 70	,,	5 Open	,,	3,750	2,000	6	,,	12,000
Royal Exchange Avenue	73	60	,,	1 Open	,,	750	2,000	1	Post	2,000
St. Andrew's Street	118	50	,,	2 Open	,,	1,500	2,000	2	Centrally hung	4,000
St. Bride Street	168	50	,,	3 Open; 1 Enclosed	,,	2,750	2,000	3	,,	8,000
							2,000	1	Rest	
Shoe Lane (part)	127	58	,,	2 Open	,,	1,500	2,000	2	Centrally hung	4,000
Snow Hill	200	52	,,	1 Flame; 3 Open; 1 Enclosed	,,	4,250	2,000	5	,,	12,150
							2,000	1	Rest	
							75	2	Rest	
South Place	120	70	Electric and gas (10 in.)	2 Open; 1 60 ft.	,,	3,300	2,000	2	Centrally hung	6,000
							2,000	1	Rest	
Threadneedle Street	380	50	Electric	8 Open	,,	6,000	2,000	3	Posts	11,200
							2,000	2	Centrally hung	
							300	4	Rests	
Walbrook—opposite Mansion House	53	60	,,	1 Flame	,,	1,500	2,000	1	Post	2,000
West Smithfield	267	55	Electric and gas	6 Flame; 7 8½; 1 4¼	,,	10,105	2,000	6	Posts	12,000
St. Paul's Churchyard	607	50	Electric	12 Flame	,,	18,000	2,000	12	,,	24,000
Bartholomew Lane	87	60	Electric	1 Open	,,	750	200	1	,,	200

* Seven of these lamps will be extinguished at midnight.

SCHEME OF THE CITY OF LONDON ELECTRIC LIGHTING COMPANY—*Continued.*

Thoroughfare.	Approximate Length in Yards.	Approximate Width in Feet.	Existing. How Lighted.	Existing. Number and Size of Lamps.	Existing. Description of Fixing.	Existing. Estimated Total Candle Power.	Proposed. Candle Power of Burner.	Proposed. Number of Lamps.	Proposed. Description of Fixing.	Proposed. Total Candle Power.
Lothbury	187	45	Electric and gas	1 Flame 3 Open 1 4½	Column	3,815	2,000 2,000	2 2	Centrally hung Posts	8,000
Middlesex Street	596	40 to 60	Electric and gas	13 Open 2 4½	Column & bracket	9,880	2,000 2,000	13 2	Centrally hung Posts	30,000
Arthur Street East	133	40	Electric	2 Open	Column	1,500	2,000	2	Centrally hung	4,000
Barbican	207	48	Electric and gas	4 ,, 1 4½	,,	3,065	2,000	4	,,	8,000
Beech Street	120	38	Electric	2 Open	,,	1,500	2,000	2	,,	4,000
Billiter Street	143	35	,,	3 ,,	,,	2,250	2,000	3	,,	6,000
Coleman Street	327	40	,,	4 ,,	Column & bracket	3,000	2,000	4	,,	8,000
Fore Street	440	48	Electric and gas	9 Open 2 8½	,, ,,	7,010	2,000	10	,,	20,000
Golden Lane (part)	126	50	Electric	1 Open	Column	750	100	1	Post	100
Gresham Street	487	40	Electric	11 ,,	Column & bracket	8,250	2,000	11	Centrally hung	22,000
Houndsditch	490	40	Electric and gas	9 ,, 1 4½	Column	6,815	2,000	10	,,	20,000
Jewin Street	210	40	Electric	4 Open	Column	3,000	2,000	4	,,	8,000
Lombard Street (part)	310	30 to 65	,,	5 ,,	,,	3,750	2,000	5	,,	10,000
Lloyd's Avenue	86	40	,,	4 ,,	,,	3,000	2,000	3	,,	6,000
Crutched Friars—Centre on Convenience	—	—	,,	1 ,,	,,	750	2,000	1	Rest	2,000
Queenhithe—Centre (Convenience)	—	—	,,	1 ,, 2 ,,	,,	750	2,000	1	,,	2,000
Old Bailey	240	35	Electric and gas	3 Flame 2 4½	Column & bracket	6,130	2,000 2,000 100	4 1 1	Centrally hung Rest ,,	10,100
Red Cross Street	160	40	Electric and gas	4 Open 1 4½	Column	3,065	2,000 100	4 1	Centrally hung Rest	8,100
St. Mary Axe	300	35	Electric	5 Open	Column & bracket	3,750	2,000	3	Centrally hung	6,000
Upper Thames Street	1,267	40	Electric and gas	23 ,, 2 8½ 5 4½	Column & bracket	17,835	2,000 2,000	23 1	,, Bracket	48,000
Wormwood Street	133	30	Electric	3 Open	Brackets	2,250	2,000	2	Centrally hung	4,000
Watling Street—and side streets and courts as at present experimentally lighted	Various	Various	,,	18 Various	Centrally hung and brackets	9,650	3,000 300 100 75	4 2 6 6	,, ,, Brackets ,,	13,650
Paternoster Row do.	250	20	,,	9 Metallic Filaments	Bracket	675	75	9	,,	675

NOTES.

Lighting as existed previous to last year's experiments.
The total annual cost of the existing electric lighting amounts to the sum of £10,774 10s.; while the cost of the new lighting will be £7,312 17s. 6d. per annum.
The number of the different unit lamps will be subject to adjustment as may be found necessary when dealing with each area or street in detail.

accident by the falling of a lamp. In conclusion, Mr. Gunton pointed out that it was an important step which the Corporation were about to take; but he said that when the City streets were lighted as it was intended they would be, an example would be set to the cities of the United Kingdom, and would, he believed, cause other large towns and centres of population to be better lighted.

There will be some 300 or 400 centrally-hung electric flame lamps, and some 50 high-pressure gas-lamps of similar candle power; while about 50 high-pressure gas-lamps of 2000-candle power will be erected on columns. All the principal thoroughfares, with the exception of Queen Victoria Street, New Bridge Street, and Mansion House Street, will be lighted by centrally-hung lamps; these three thoroughfares being lighted by high-pressure gas-lamps on columns. The majority of the lamps will be of 2000-candle power, except in minor streets, in which case inverted gas-mantles, giving 90, 180, and 240 candle power respectively, will take the places of upright burners of 65-candle power, in a specially designed acorn-shaped globe lamp, without any ribs to obscure the light.

To light the City by this system of centrally-hung lamps is only possible owing to the fact that the Corporation, under their Act of 1900, possess special power which enables them to affix to the front of any and every building abutting on the public thoroughfare, pipes, wires, services, and attachments. By this means, all lamp-posts will be swept off the footpaths.

On the whole, the Corporation can be congratulated on their report; for once more will the City of London take its position in the front rank of the best-lighted cities, even as it is the best drained, paved, cleansed, and policed, as becomes the Metropolis of the Empire.

Peat as a Gas Producer.—According to a paragraph in the "Ironmongers' Chronicle and Hardwareman," Mr. Hamilton Robb, of Portadown, has succeeded in producing from peat a gas which he is able to utilize for driving the plant, of 400 B.H.P., in his weaving factory. The peat blocks are put into a feeding-hopper, from which they pass into a generator, where gasification of the fuel takes place by partial combustion. Crude gas is formed, and by means of an exhauster fan the gas is drawn off, cooled, and purified; all tarry products being removed, and the clean gas passed into a holder. From this it is supplied to the gas-engines used for developing the power required to drive the 500 looms in the factory.

THE LAST GAS EXAMINATIONS.

Report of the City and Guilds of London Institute.

We have received from the Superintendent of the Department of Technology of the City and Guilds of London Institute (Sir Philip Magnus, M.P.) the report on the work of the department during last session. We extract from it some particulars as to the examinations conducted in "Gas Engineering" and "Gas Supply."

As showing the extent of the work of the department, it may be mentioned that at the recent general examination in technology 24,342 candidates were presented from 465 centres in the United Kingdom; and 14,206 of them passed. By including the candidates from India and the Overseas Dominions, and those for the teachers' certificates in manual training and domestic subjects, the total number of examinees was 27,205. These figures show an increase on those of any previous year. As readers may remember, in order to secure the expert advice of trade societies and professional bodies in the conduct of the department's educational work, the Institute have arranged for the formation of several Advisory Committees, consisting of persons interested in different trades and industries. The functions of each Committee are to suggest improvement in the Institute's syllabus of instruction, to recommend new examiners for appointment, and generally to advise on any matter connected with the course of instruction or the examinations which may be referred to them. The Council of the Institution of Gas Engineers act as an Advisory Committee in the subjects of "Gas Engineering" and "Gas Supply." By the aid of these Committees, the Institute are enabled to promote useful relations between trade organizations and the schools in which artisans and others receive technical instruction. The Society of British Gas Industries have offered prizes to the candidates who take the highest places in the final examinations in the two subjects just named.

Coming to the general work of the department, we find that the number of subjects in which examinations were held last session was 75—the same as before; and the number of separate classes was 4495, against 4329—the former figure being the highest on record. The number of students in attendance, however, was 52,680, compared with 53,227. In the subjects of "Gas Engineering" and "Gas Supply," the number of students increased from 757 to 980; and that of the candidates from 614 to 699—a

small decrease in the numbers presented for the former subject being more than compensated by a large increase (from 310 to 428) of those entering in the other branch of the industry. The programme for the session 1911-12 was issued in July, and was noticed in the "JOURNAL" for Aug. 1 (p. 285).

Turning to the tables which give the results in the separate subjects, the report shows that in the two relating to gas there were 28 centres, with (as already mentioned) 980 students in attendance, compared with 26 and 757 before. The candidates numbered 271 in "Gas Engineering," and 428 in "Gas Supply," compared with 304 and 310 before. In the Honours grade, in the former subject, 43 passed in the first class, 26 in the second class, and 25 failed; while in the Ordinary grade the passes were 37 and 58 respectively, and the failures 82. There were thus 164 passes and 107 failures, or 39·4 per cent. In the Honours grade in "Gas Supply," 21 candidates passed in the first class, 37 in the second, and 31 failed; while in the Ordinary grade 105 passed in the first class, 132 in the second, and 102 failed. There were thus 295 passes and 133 failures, or 31 per cent.

Of the total number of students in the two subjects, the only one who was examined from the Battersea Polytechnic passed in the Ordinary grade in "Gas Supply." At the Goldsmiths' College, out of 22 students in attendance, 13 were examined and 8 passed in this subject—5 in the Ordinary and 3 in the Honours grade—and one in the Ordinary grade in "Gas Engineering." At the Northern Polytechnic, one candidate was examined in this subject, and he passed in the Honours grade. From the classes at the Regent Street Polytechnic, 31 students out of 51 were examined in "Gas Engineering," and 3 in "Gas Supply." Of the former, 12 passed in the Ordinary and 14 in the Honours grade; and there were two prize winners. Of the 3 candidates examined in "Gas Supply," 2 passed in the Ordinary and 1 in the Honours grade. From the various schools of the London County Council, out of 185 students in attendance at classes for "Gas Supply," 69 were examined, 35 of whom passed in the Ordinary and 8 in the Honours grade. One candidate was examined at Lithgow (New South Wales) in both "Gas Engineering" and "Gas Supply," and he passed first class in the Honours grade in each subject. At Wellington (N.Z.), one candidate was examined in "Gas Engineering;" and he passed in the Ordinary grade.

Reporting upon the work of the students in "Gas Engineering," the Examiner (Mr. Thomas Glover) says:—

> The answers to the chemistry questions show, on the whole, a good knowledge of this side of modern gas-works practice; but the power to draw satisfactorily an elevation or a section of gas-works apparatus or plant is, in many cases, distinctly weak. Dip-pipes are frequently shown attached to hydraulic-main covers without flanges; retort-settings are drawn without any idea of proportion or correct measurement; while the arrangement of retorts sketched in many of the answers displays a lack of observation on the part of students. It cannot be made too clear that students of "Gas Engineering" desiring to fit themselves to occupy positions of trust in connection with gas-works management must learn to sketch and draw neatly and accurately.
>
> While the general impression as to the power of students to express their knowledge in drawings and sketches is poor, there was, nevertheless, some excellent work done at the examination; and one group of students had evidently been well taught to draw a section of hydraulic main and its connections. In the Honours examination there were papers from students of distinct ability; and some also from candidates who would have been well advised if they had decided to wait a few years to gain more experience before presenting themselves for examination. The calorific value of blue water gas did not appear to be known by many candidates; and the mistake was frequently made of assuming that a mixture of 85 per cent. of coal gas and 15 per cent. of water gas would have a higher calorific value than pure coal gas. The descriptions given of the calorimeter were, in most cases, excellent. Distinct progress is observable in the knowledge of naphthalene formation and its subsequent removal; also in the understanding of the difference between heavy charge and long period, as against light charge and short period, carbonization.

Mr. J. H. Brearley, the Examiner in "Gas Supply," reports as follows:—

> There is an increase of over 50 per cent. in the number of candidates who presented themselves in the Ordinary grade; the exact numbers for the preceding year and the present year being 217 and 339 respectively. It is pleasing to find that the quality of the work done has also considerably improved. Out of the number who presented themselves this year, only 34 candidates obtained less than 30 per cent. of the total possible marks. It is quite evident that greater facilities for systematic training are being provided by educational institutions.
>
> Several candidates failed to observe the rules printed on the first page of the question paper. Though it is clearly stated that where there are two alternatives (*a*) and (*b*) only one is to be answered, yet there were several instances where both alternatives were answered. In these circumstances, the answer to the second alternative was cancelled. Quite a large number of candidates lost marks by not reading the questions carefully. The principal point in No. 1 (*a*), for example, which refers to an escape of gas passing along a disused drain, was entirely overlooked by several of those who attempted this question. Question No. 10, which refers to the breaking of the porcelain ignition-tubes of a gas-engine, clearly states that the tubes were fixed correctly, were of approved quality, and the ignition-valve was in perfect order—points which seemed to escape the notice of nearly all those who attempted the answering of this question.
>
> There is no increase in the number of candidates sitting for the Honours grade; and it cannot be said that there is an improvement, as compared with last year, in the quality of the papers submitted. The questions may have been a little more difficult than those set in the previous year; but the standard in this grade is naturally high, considering that there is no other examination test of a man's fitness for such responsible positions as that of district superintendent. Candidates for the Honours grade should keep abreast of the latest developments in the way of research and invention as described in the journals devoted to gas supply. It should also be remembered that if a first-class diploma is not easy to secure, it is all the more valuable.

The questions in "Gas Engineering" were given in the "JOURNAL" for May 2 last (p. 316), and those in "Gas Supply" in the next issue (p. 392). The names of the successful candidates in both subjects will be found in the number for June 27 (p. 1008); and those of the prize winners in the issue for Aug. 8 (p. 349).

AN INCANDESCENT SUN BURNER

AT THE ROYAL SANITARY INSTITUTE.

LITTLE more than twelve months ago, there appeared in the columns of the "JOURNAL" an account of the eviction of electricity from the meeting and exhibition rooms of the Society of Medical Officers of Health, and the substitution for it of gas. Having regard particularly to the profession to which the members of the Society referred to belong, the importance of the step adopted, as a refutation of the bad old prejudices against gas, was fully realized; and the fact is not likely to be forgotten.

Another scientific body may just at the present time be quoted as enjoying the benefits of a combined gas lighting and ventilating arrangement of a highly efficient character. This is the Royal Sanitary Institute, in the commodious library and lecture hall of whose handsome new premises in Buckingham Palace Road, S.W., there has been constructed and fixed by Mr. William Edgar, of Hammersmith (on behalf of the Gaslight and Coke Company), an incandescent sun-burner which leaves nothing to be desired. It is true that in this instance there has been no eviction of electricity, inasmuch as the new fitting has taken the place of an old flat-flame sun-burner, and there are still some electric lamps about the place. But in other respects, the cases are very similar—that is to say, gas, under up-to-date conditions, is found to give every satisfaction when utilized in a position where it must be subjected to the keenly critical judgment of men who are professionally and scientifically peculiarly interested in matters of hygiene. The new lamp at the Royal Sanitary Institute does, indeed, give "every satisfaction."

In the design of the lamp now under notice, it may be said, use and ornament have been well combined; for, in addition to being highly effective, the whole arrangement is exceedingly artistic. It has been named by Mr. Edgar the "Colombo" ventilating gas-lamp; and it consists of a circular ceiling fitting constructed of polished brass and copper, surmounted by a heavily moulded plaster ceiling-rose. It is 5-feet in diameter, and terminates with an enamelled reflector relieved by an ornamental brass centre; and there is contained in it a cluster of eight large incandescent burners. Bye-passes are fitted for each burner, and both main and bye-pass supplies are controlled by indicating taps, fixed in a convenient position on the wall. These taps are encased in a locked-up receptacle, to prevent unauthorized persons tampering with them. Each burner is provided with gas and air adjusters, which are brought through the reflector, close to each other, for easy manipulation. There is a gallery round the hall; and as the light emitted is directly in the line of vision of persons sitting there, the burners are fitted with satin green opalescent globes, which are wired, and have a specially constructed holder. At the top of the lamp there is a mercurial seal, which acts effectively. The thorough ventilation of the hall is secured by a series of tubes, in which the heat generated by the lamp sets up a draught that carries the vitiated air outside the building.

It is stated that by the new arrangement a great saving in gas consumption has been effected. The old fitting contained sixty-four flat-flame burners, consuming about 300 cubic feet per hour; whereas the new light, comprising eight burners, consumes 40 cubic feet per hour, and is calculated to give a light of somewhere about 1400-candle power. And the light is as good in quality as it is in quantity.

The installation meeting of the East Medina Chapter of Royal Arch Masons was held on Monday last week at Ryde, when Ex. Comp. F. F. Farrand, the Manager of the Ryde Gaslight Company, was placed in the first chair, *Z*.

The Executive Committee of the Sir Samuel Sadler Memorial Fund have decided that the memorial should take the form of a statue; and that the Corporation of Middlesbrough should be asked, through the General Purposes Committee, if they would grant and prepare a site for the statue in Victoria Square.

An excellently printed pamphlet has been issued by Messrs. Mansfield and Sons, Limited, of Birkenhead, drawing attention to the usefulness of their oil-gas apparatus for laboratories which happen to be removed from the advantages of a supply of town gas. The information given is of a very complete character; and the plant is fully illustrated. Prices and particulars of laboratory gas appliances are also included.

MANCHESTER UNIVERSITY LECTURES.

The second of the series of lectures for the present session at the Manchester University, in continuation of the movement inaugurated at the beginning of last year by the Manchester District Junior Gas Association, and supported by the Manchester District Institution of Gas Engineers, was delivered on Saturday in the Chemistry Theatre of the University by Mr. E. W. Smith, M.Sc. (Manchester), of the High-Pressure Gas Laboratories, Birmingham, who followed up his first lecture on "High-Pressure Gas Distribution" with one on the "Theory and Practice of the Application of High-Pressure Gas. This lecture will be found on pp. 699-702. There was a large attendance. Mr. R. G. Shadbolt, of Grantham, the President of the Institution of Gas Engineers, occupied the chair, and was supported by Professor Harold B. Dixon, Ph.D., F.R.S., of Manchester University (who has taken an active part in the arrangement of the lectures), Mr. W. Whatmough (Heywood), Mr. S. Meunier (Stockport), Mr. A. L. Holton (President of the Manchester Junior Association), Mr. D. V. Hollingworth, F.S.C. (President-Elect), Mr. J. Alsop (Hon. Secretary), and Mr. J. W. Singleton (Fletcher, Russell, and Co.).

The Chairman, in opening the proceedings, said it was with feelings of pleasure that he received the invitation to preside; and those present would readily understand this when he mentioned that it was during the year he was President of the Manchester District Institution that the Junior Association was formed, and also that it was the first invitation he had on taking up duty as President of the Institution of Gas Engineers. The movement inaugurated by the Manchester Junior Association had during the past twelve years made wonderful progress; and similar organizations were now established in other parts of the country, all of which were giving a good account of themselves. It was with pleasure, too, that one noted how the Manchester Association were keeping themselves right in the forefront in practical and technical work, so that the members might be the better equipped for the duties they had to perform. This was more important seeing that quite recently gas engineers had been girded at—ignorantly, he believed—as being very ordinary and very unscientific, especially when compared with those engaged in another industry. But if one had to take all things into consideration—the conditions which prevailed in the time of the pioneers of the gas industry, and those obtaining now—well, comparisons might be somewhat odious. There was no doubt the rising gas engineer of to-day was a thoroughly practical, technical, and scientific force, ready to take his place in his own particular industry; and he (Mr. Shadbolt) said most emphatically that in no other industry of a commercial character were more capable, more thorough, and more scientific (in the strict sense of the term) men being produced than was the case with the gas industry of to-day. He was prompted to make these observations on an occasion like this, because of the questions which were frequently raised in certain quarters to the detriment of such Associations as theirs. As to the lecturer for the afternoon, he was a gentleman well known to many of them—one who had distinguished himself already in the work he had taken up. The services Mr. Smith had rendered at Leeds University in connection with research work were very valuable indeed; and in the position he now occupied at Birmingham, he had a unique opportunity of developing and perfecting his knowledge as to high-pressure gas. In his (Mr. Shadbolt's) opinion, Mr. Smith was destined to make his mark in the gas world in this particular respect, and needed really no introduction from him to the meeting. The subject he was dealing with was a vast one; and the possibilities, particularly from an industrial point of view, were indeed great. The application of gas under high pressure had of late increased and magnified in a remarkable degree. But, until they could meet fully, in this respect, the requirements of the industrial world of to-day, the gas industry would, of course, suffer, and industry in general would suffer. The great desideratum in the industrial world in relation to the supply of power was that it should always be at hand, that it should be under control, and that it should never fail.

Mr. Smith then proceeded to deliver his lecture, and at its conclusion gave a number of practical demonstrations to illustrate various points he had raised; apparatus having been loaned for the purpose by various firms, including Messrs. Fletcher, Russell, and Co., and the Richmond Gas and Stove and Meter Company. There were seen in operation a small crucible furnace, in which copper was melted by high-power gas; high-power gas-burners for boiling large quantities of water, &c.; and an oven-furnace, soldering irons, and so on.

Following an adjournment for tea, a discussion took place *in camerâ*, when Mr. Smith answered a number of questions put by members of both Associations.

Mr. W. Whatmough (Heywood) subsequently moved a vote of thanks to the lecturer. Mr. Smith, he said, was a valuable asset in the gas profession. They all knew the great work he did at Leeds University in regard to gas-fires, and no doubt much of the improvement seen in gas-fires now was in no small measure due to his research work at the University. There were some gas engineers who would have liked to see Mr. Smith continue this research work at Leeds University; but all rejoiced that, in his going to Birmingham, the gas industry had not lost his services. The lecture Mr. Smith gave at the Glasgow meeting of the Gas Institution, and those delivered at the Manchester University, on high-pressure, would be as works of reference on the subject for a long time to come.

Mr. W. L. Heald (Preston), in seconding the motion, maintained that in no county had high-pressure gas lighting made such progress as was the case with Lancashire, perhaps because they had such a large number of factories there. He would have liked Mr. Smith to have dealt more with the application of high-pressure gas for lighting purposes than he had done.

The motion having been carried with applause,

Mr. Smith, in reply, said he should like the vote to include Mr. C. M. Walters, his Chief Assistant, who had been of invaluable service to him at Birmingham, and Mr. Franklin Thorp (of Manchester) for the help that he had given in regard to getting appliances from the makers for the purposes of illustrating the lecture that afternoon. As to Mr. Whatmough's observation about his leaving Leeds University, Mr. Smith said that at Birmingham he had much greater facilities and opportunities for carrying on his work than was possible at the University, or, perhaps, anywhere else. In regard to the remark made by Mr. Heald, he was certainly under the impression that it was gaseous heating they wanted him to deal with in his lectures, and not high-pressure gas lighting, which would require another lecture. He had not dealt with high-pressure gas lighting, simply because he understood they did not want it.

Mr. S. E. Halliwell (Littleborough) moved a vote of thanks to Mr. Shadbolt for presiding—observing that they all very much appreciated the presence of the President of the Institution of Gas Engineers, because it showed not only the deep interest he took personally in their Association and the lectures, but that they had the support and sympathy of the national institution in their industry in this movement—a movement which aimed at raising the standard of the members of the Junior Association. He thought the Council of the Association were to be congratulated on their list of Chairmen. They had had not only representatives of corporation gas undertakings, private companies, the Senior Gas Association, and the parent body, but of the University itself. In fact, it seemed to him that they had in this work of theirs got "recognition" all round. The attendance at the lectures showed the eagerness of the members to advance the profession to which they belonged and make themselves more fitted for their work.

Mr. F. Thorp seconded; and the motion having been carried,

Mr. Shadbolt briefly responded—remarking that he had thoroughly enjoyed himself that day.

The next lecture will take place on Jan. 13, when the Lord Mayor of Manchester (Mr. S. W. Royse) has promised to preside. The lecturer on this occasion will be Professor E. Rutherford, D.Sc., F.R.S., of Manchester University, who will have for his subject "Radio-Activity." The same afternoon Mr. C. H. Foden will give an address dealing with "Gas-Works Accountancy."

HOLDERS FROM THE ARTISTIC POINT OF VIEW.

It may be recalled that at the meeting of shareholders in the Imperial Continental Gas Association on the 7th ult., Mr. J. Horsley Palmer, the Chairman, referred to the fact that the large gasholder which had been built for the Association at its Schöneberg works in Berlin had not, owing to a concatenation of misfortunes, yet been brought into use [*ante*, p. 476].

This gasholder is of 150,000 cubic metres (about 5 million cubic feet) capacity, and is not enclosed in a house as are the majority of the gasholders in and around Berlin. It appears that there has been a movement on the part of members of the City Council, having for its object the prevention of the use of this new gasholder, on the ground that it is an eyesore and spoils the appearance of the town. This view seems to have been held by a majority of the Council; but a distinguished art critic, Herr Fritz Stahl, has contributed an article to the "Berliner Tageblatt," in which he discusses the æsthetic aspect of gasholders and similar utilitarian steel structures. Herr Stahl, after saying that if the objections raised to the gasholder in reality indicated a growing sense of the importance of the beautiful in town planning, he would gladly recognize the agitation against the new holder as praiseworthy. But he regarded it as based on a misconception of the relation of the form of structures to utility. The modern town could not be built in the idyllic Old Frank fashion; and it would be absurd, for instance, to retain artistic angles in streets where there was much fast traffic. Similarly it was absurd to protest against a structure which was necessary, and to which there was no real alternative meeting the requirements of the case. As to the question of whether the holder had been erected in the wrong position for such a structure, he could see no damage to the surroundings, as it was on the outskirts of the city, and in a place where there would be no representative public buildings or even high-class private buildings. He traced the development in gasholder construction from the time of the oldest gasholders in Berlin, which are at the Gitschinerstrasse works, and pointed out that each new holder in turn represented the best spirit of the age in regard to such structures. As a fact, the new gasholder had, in his opinion, a rather pleasing effect when viewed from a little distance. He pointed out that there were many recent cases of false architecture in Berlin, which should come under the ban of the City Council much more deservedly than the Schöneberg gasholder.

A SURVEY OF GAS PHOTOMETRY AND CALORIMETRY

FROM AN AMERICAN STANDPOINT.

At the request of the Chairman of the Technical Committee of the American Gas Institute, a paper on gas photometry was submitted by Mr. CHARLES O. BOND, the Chief Photometrist at the Philadelphia Gas-Works, at the recent annual meeting of the Institute. It was a general survey of photometry and calorimetry. The following is an abstract of it.

The author divided his paper into three parts. In the first, he offered some remarks in regard to the International Photometric Commission; the second consisted of the collection of the unfinished business left from other papers on gas photometry submitted to the Institute; and in the third he reviewed the present position of gas photometry in the United States.

On the first subject, Mr. Bond said it was one of so much importance as to merit recognition well beyond the limits of a personal communication. He thought it was unfortunate that the American delegates had not been able to attend the sittings of the Commission, for through their reports the Institute would have been kept in closer touch with foreign thought on matters concerning the gas industry. The importance of the subject-matters dealt with, and the high standing of the engineers and scientists comprising the Commission, would make the reports valuable indeed to the members of the Institute. To instance several of these papers, the author mentioned one by Mr. Charles Carpenter, detailing the development of the "Metropolitan" No. 2 test-burner; the classical researches by M. Sainte-Claire Deville on the relation between the heating value and luminosity of gas, and the three National Laboratory comparisons of standards of light, to which credit must, he said, be given for stimulating the investigations which had led up to the proposed international candle. In an appendix, he gave a brief account of the formation and work of the Commission so far—sufficient, he thought, to warrant instructions to the Institute's new delegates to prepare a full report on the three Zurich sessions for insertion as an appendix to the Institute "Proceedings;" and he suggested a yearly progress report from the delegates as helpful.

With regard to the unfinished business, the author found, in looking over the five volumes of the "Proceedings," that communications having a bearing on photometry had been made by (besides himself) Messrs. Doty, Lansingh, Gartley, Hyde, Litle, Macbeth, and Bradley. While much of a very definite character had been accomplished by, or as a result of, these communications, there were at least two unfinished subjects of such importance as to warrant again calling the attention of the Institute to them—viz., the calorific test and the photometric test as a criterion of gas quality, and a standard test burner. He agreed with the statement of the President at last year's meeting (Mr. W. H. Bradley) that this was perhaps the question of greatest importance now before the gas industry.

THE CALORIMETRY OF GAS.

Dealing with this subject, the author showed how gas, though in its early days supplied for the purpose of giving light, contains energy which it is the business of those engaged in the gas industry to render available for use in a satisfactory form. The conversion of this energy should be tested by a highly efficient scientific instrument, in order that the efficiency of the conversion might be accurately known. The calorimeter, which has an efficiency of 99·5 per cent., answered this requirement. Gas was now valuable for heating, power, and incandescent lighting, in accordance with its calorific content; and if it were not for the fact that a portion of the gas supplied was still used in open flames, the calorimeter would be logically the only testing instrument. The author pointed out that the energy in gas coal, through the use of vertical retorts and the bye-product coke in water-gas generators, is to-day about 58 per cent. recoverable as gaseous energy, which, when applied to a good commercial heating device, averages 80 per cent. utilization; when applied to the production of power, from 25 to 30 per cent.; and when applied through the mantle to the production of light, one-third of 1 per cent.

It was suggested to the author that he should write to several of the European countries and ascertain the present attitude towards the change from the photometric to the calorific test. He did so, and the results are given in an appendix to his paper. As the International Photometric Commission, with delegates from the same countries, and representing the same Gas Associations, discussed this subject at their last meeting, he gave their views upon it, which may be expressed briefly as follows: Dr. Eitner (Germany) stated that the substitution of the calorific test would be effected gradually. They had begun to allow a gross calorific value of from 5000 to 5200 calories per cubic metre (531 to 553 B.Th.U. gross per cubic foot); the illuminating power being from 10 to 12 hefners per 150 litres (9 to 10·8 candles per 5·3 cubic feet). Dr. Harold G. Colman (England) stated that the English engineers were not opposed to the introduction of the calorific power test, but were opposed to a dual test. M. Sainte-Claire Deville (France) strongly urged the replacing of the examination of illuminating power by that of calorific power. Dr. Strache (Austria) stated that in his country they had begun to accept the gross calorific power. The Commission expressed the opinion that, having regard to the methods of employing gas at present in vogue, "the determination of the illuminating power of gas-flames has lost its significance, and that the determination of calorific power ought to take the place of the determination of illuminating power as the essential criterion of the value of gas."

THE STANDARD TEST-BURNER.

Passing to the above subject, the author said: If the self-luminous flame horizontal candle power of gas is to be retained in America as a method of test, it is high time that definite approval should be given by the Institute to some form of test-burner. We can well observe the action of the Canadian Gas Association in this matter. It was thought desirable by the Association to place the testing of gases in Canada upon a uniform national basis. The Association Executive accordingly sent delegates to the Government at Ottawa, who conferred with the proper authorities and secured the sanction of the Government for the general use throughout Canada of the "Metropolitan" No. 2 burner. A similar result at Washington would seem to be possible, if the Institute really desires to continue the photometric test and is ready to act. In the discussion of a standard test-burner, we should remember, however, that thus far the horizontal candle power only has been used as a test; and the progressive design of the test-burner has been, whether intentional or not, towards increased light in that plane. Had the efficiency of these burners been judged on the basis of the mean spherical candle power, or had a rich gas been used during the testing, the design might have proceeded along somewhat different lines. [The author gave several distribution curves in a vertical plane of the light from several burners used for testing purposes, together with the results in terms of the mean spherical candle power.] The flat-flame burner is almost a spherical distributor of light; while the argand flame, glass-enclosed, elongated, and locally raised in temperature, shows curves bulged somewhat more favourably for horizontal candle power. The old flat-flame test-burner, in the days when such burners were in practically exclusive use, was, therefore, a fair criterion of the total flux of light. The Carpenter burner, which is the most efficient of its class, particularly for coal gas, has an accurate control of the air supply to a flame.

Referring to the Carpenter burner, Mr. C. H. Stone, formerly of the New York State Public Service Commission, said: "Now the question immediately arises, Why should not this burner be employed in every case—at least, for coal gas? The answer to this will be found in the consideration of two or three facts. In Massachusetts, the law requires that the gas shall be tested with the burner best adapted to it, which is at the same time practical for use by the consumer; and the authorities in the State have interpreted this to mean a burner which is not only satisfactory in its mechanical details, but which in cost is within the reach of everyone. The price of the 'Metropolitan' No. 2 burner is $25; and this would seem to place it beyond the reach of most consumers." There is here a fallacy in the argument. Since higher efficiency burners came in, there has been little thought, I take it, that the photometric test exactly measured the quantity of light the consumer could get. The photometric test was regarded as a qualitative measure of the gas; and the aim was to hold this quality, however measured. Such a measurement should be made, and the quality should be held, through a scientific burner, whatever its cost.

For richer gases, the Carpenter burner gives no more light than the open flame. This is because its dimensions are not correct for these gases, it having been designed more particularly for coal gas. Another standard test-burner adaptable to gases of from 16 to 26 candles should therefore be specified for this range. The points to be made are that the test-burner adopted should be scientifically designed, exactly constructed, and uniform the country over for similar gases. We should then be able to compare results satisfactorily, and the public could be assured that the photometric quality of their gas was unchanged.

While purely academic, and perhaps of little practical value, we still may speculate somewhat upon another form of test-burner which would furnish a criterion not only of the actual light received by the consumer, but also of the total energy in the gas. Such a test-burner would be ideal if it were 100 per cent. efficient in transforming gaseous energy into light. And it would be even satisfactory if the transforming efficiency simply remained constant. Now, M. Sainte-Claire Deville's researches in Paris, repeated by, and practically concurred in by, Dr. Max Mayer at Karlsruhe, claim a practical constancy of the ratio existing between the calorific value and the absolute incandescent value of luminous gases within the ranges of manufacture; and the calorific value represents the total energy in the gas.

The term "absolute" lighting value is the maximum horizontal candle power per cubic foot per hour obtainable—the burner being supplied with dry air and saturated gas at the same temperature and pressure. It is no doubt true that a constant relation exists between this horizontal candle power and the mean spherical candle power. Therefore, if the findings are true, and we sought such a test, we might advocate for testing purposes an

incandescent mantle burner of current high efficiency which fulfils the conditions above named for a satisfactory test-burner the cost of which is within the reach of everyone, and in using which we should determine the "absolute" mean spherical candle power.

Gas Photometry in the United States.

Coming to the third division of his subject, the author made the following remarks: Whatever the future may have in store for gas companies, we must recognize the fact that, owing to the existing franchises and contracts, a very large proportion of the gas used in America must still pass a photometric test. There must be photometrists connected with the companies capable of accurately making such tests; and there must be well-standardized apparatus with which they may work. As to light standards, we can say, with more confidence to-day than ever before, that the pentane lamp is more likely to be a satisfactory primary flame standard than any other, and that the Bureau of Standards at Washington has investigated this lamp thoroughly, and the officials hold to-day a high opinion of its reliability.

Owing partly to the influence of our Illuminating Engineering Society, and partly to the epochal studies in radiation which have been made in recent years, the subject of photometry has grown out of its former modest and primitive domain. We gas men have been acting all these years as if the photometer were simply one more piece of apparatus in the gas plant, like a condenser or a meter dial, to be knocked about and condemned if it did not produce what we expected. We have suddenly awakened to the fact that the real photometer is that precious possession, the human eye; and the intermediaries of mirrors, graduated arcs, and test-plates are being called into requisition by the eye in the fight for its rights. There is need. If this statement is doubted, call in the ocular testimony from the children of the public schools. It is for this reason that Societies for the Conservation of Vision are now being founded. No doubt half of the retinal harm is done under natural light. But this does not discharge our obligations to present blameless our quota of artificial light; for while the child both studies and recites by day, at night there is study only, and we furnish the light by which that study occurs. Every manager of a gas undertaking should be as familiar with the term "foot-candle" as he long has been with the term "candle-feet." The "candle" in the term "candle-feet" has become habitual, and is to the gas manager simply part of his yield for the day—regarded as a physical, commercial quantity. The "candle" in the term "foot-candle," on the other hand, is the physiological measure of his service to those whom he essays to "light;" and it should involve the element of quality as well as quantity.

It seems plain, then, that in the gas industry the photometer must widen its area of usefulness, leave the gas-works, and begin to travel. Conditions are reversed; and instead of the eye coming to it, the photometer must travel for or with the eye. There must be radial photometers, travelling over the surface of imaginary luminous spheres, or else surrounding them as does the integrating sphere; and there must be illuminometers—portable companions of the eye—by which the success or failure of a lighting installation may be measured and valued *in situ*. Progressive gas undertakings are buying both kinds for use; and who will doubt that business will be easiest held and increased by those who call in the aid of science, and are prepared to give visible backing of their arguments. As of old, "Seeing is believing."

But this kind of photometry almost at once leaves behind the open gas-flame. It becomes incandescent gas photometry; and new difficulties are presented. This was the cause of the formation of the International Photometric Commission. At least two most valuable conclusions have been reached through the efforts of this body, as remarked earlier in my paper—viz., (1) a common unit of light intensity, and (2) the establishment of a practical relation between the calorific and incandescent lighting value of gas. The first you may make use of by having your pentane lamps calibrated and certified in international candles at Washington. The second helps, because whatever artificial illuminating gas we use, we feel that by rating either a lamp or a mantle in terms of "lumens per B.Th.U. per hour" we really have a tangible efficiency factor.

The Chairman of the Technical Committee has no doubt been disappointed in his expectation of a highly technical treatment of the subject; but it seems to me that the gas industry to-day is not so much in need of mental "nuts-to-crack" (photometrically speaking), as of a general stirring of the rank and file with the determination to put into use the results already laid before them by the new photometry. There must be a deepening of the sense of moral obligation, so that when a consumer places his confidence in us and asks for light, we shall not requite him with either flickering flame or blinding glare, but the best we know, and placed with care.

A Useful Letter of Inquiry.

As already mentioned, the author furnished additional particulars in appendices to his paper. The first appendix consisted for the most part of a sketch of the origin and work of the International Photometrical Commission, extracted from the "Transactions" of the Institution of Gas Engineers, and (as regards the third sitting) from the "Journal." The second appendix contained information on the subject of the substitution of the calorific for the photometric test of gas. It was obtained by means of a letter sent to the Secretaries of all the Gas Associations in England, France, Germany, Holland, and Italy, with a request for a brief statement in reply to the following questions:

1.—When did the change begin?
2.—Do any cases exist in which the same gas is legally subject to both tests?
3.—If the two methods of test are legalized, in what class of cities is the calorific test prescribed, and in what class is the photometric test prescribed?
4.—In general, who have requested the change to the calorific test—(*a*) the consumers, (*b*) the legislative bodies in response to scientific counsel, or (*c*) the gas companies.
5.—What is the argument usually advanced for the change?
6.—What is considered a fair calorific requirement for manufactured illuminating gas, and is this net or gross?

The following replies to the letter were received:—

From England.

In reference to your inquiries addressed to our Mr. Dunn, the Secretary of the Institution of Gas Engineers, I beg to reply as under.

(1) The change cannot be said to have generally commenced in this country as yet.

(2) Yes. In the cases of the Gaslight and Coke, South Metropolitan, and Commercial Gas Companies, all of London, under the provisions of the London Gas Act, 1905, and the Gaslight and Coke Company's Act of 1909.

(3) The two methods are only legalized in London, as answer to question No. 2; all others have a photometric test only prescribed. In the case of London, the Gaslight and Coke Company is the only Company working under penal clauses with respect to calorific tests. In the cases of the other two Companies, although calorific tests are equally compulsory with photometric tests, calorific deficiency is *not* penalized, but photometric deficiency is liable to forfeiture specified in the Act.

(4) (*a*) No. (*b*) Yes. (*c*) No, as the gas companies of this country are quite content to work under the photometric test, with a standard (generally) of about 14-candle power, at 5 cubic feet per hour, as tested with the "Metropolitan" No. 2 burner, which is rapidly displacing other standards.

(5) As there is as yet no great desire for the change, no leading line of argument for it has been adopted; but the main argument used for reduction in illuminating power standard is economy in production, accompanied by very slight calorific value, resulting in a cheaper and more efficient service to the consumer; the illuminating power of the gas, *per se*, being now of little consequence.

(6) The consensus of opinion would appear to be forming round about 125 calories net per cubic foot. In the Gaslight and Coke Company's Act of 1909, 125 calories net is adopted as the standard, but they do not incur liability for penalties unless it should fall below 112½ calories net. The following is the scale of penalties imposed for deficiencies proved below 112½ calories net: Deficiency not exceeding 3 calories net, maximum penalty £5; deficiency exceeding 3 calories and not amounting to 6 calories, maximum penalty £10; for each complete 6 calories further deficiency, penalty not less than £25, nor more than £100. Further, not more than any one authority can recover forfeiture for any one attempt.

As showing the present transitory state of the calorific standard, it is further provided in the Gaslight and Coke Company's Act of 1909 that the calorific standard may be modified, as may also the margins of deficiency and penalty, at the end of the first three or any three successive years, should it be found desirable by either the local or municipal authorities or the Company.

(Signed) R. G. Shadbolt,
President, Institution of Gas Engineers.

From Germany.

In the absence of the General Secretary, Dr. K. Bunte, I have taken cognizance of the contents of your worthy letter of July 12, and am sending for your information concerning the matter under consideration in Germany a reprint of a report which I formerly made in Frankfort.* You will see by this that in Germany, where the majority of gas installations are owned by cities, more especially in the larger cities—such as Berlin, Munich, Cologne, Breslau, Frankfort, Dusseldorf, Hamburg, Nuremburg, &c.—almost without exception the calorimetric examination is made and only rarely, unless there is a special contract, is the photometric test used. Therefore, here in Germany we may safely state that the calorimetric test is universally applied where any inspection is provided for, unless it be that prior contracts require the photometric test. The other contents of your letter will be noted later.

(Signed) H. Bunte.

From Italy.

In conformity with the promise contained in my letter to you of Aug. 24, 1911, I beg to advise you that I have communicated, through our Association, with all the leading cities of Italy, on the subject of the change from the photometric to the calorific test of gas. As a result of these inquiries, I find that, with the exception of Milan (600,000 inhabitants) and Modena (60,000 inhabitants), none of the leading cities have undertaken the calorific test, but all of them still make use of the photometric test only based on the Paris method, which is 105 litres per carcel-hour. In Milan, the calorific test was imposed by the Municipality in December, 1901, in addition to the photometric test; and the prescribed quality is 5100 calories net per cubic metre, with an allowable variation of 300 calories. In Modena, the calorific power test was imposed in 1896, specifying 3350 calories per cubic metre (this by contract); and this in addition to the illuminating power requirement of 105 litres per carcel-hour. I can give you no further authoritative information other than that in the several cities where the manufacture of gas is under municipal control there is prescribed neither illuminating nor calorific power.

(Signed) Sig. L. G. Maggioni.

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* The report mentioned by Dr. Bunte appeared in the "Journal für Gasbeleuchtung" for Sept. 18, 1909, and an English translation was given shortly afterwards in the "Journal." [See Vol. CVII., p. 831.]

THE CARBONIZATION OF COAL.

By Professor Vivian B. Lewes, F.I.C., F.C.S.

[The First of a Series of Four Cantor Lectures delivered before the Royal Society of Arts, Nov. 27.]

The whole end and aim of carbonization is to obtain as much as possible of the energy stored in coal in the condition most applicable to the uses for which it is to be employed; and as these vary over a very wide range, practical experience has led to the destructive distillation of coal being carried out mostly under two distinct sets of conditions—the one aiming at obtaining the maximum result from the gaseous products, the second at obtaining the best possible coke, while in a third, applied chiefly to shales, it is the liquid products to which most attention is paid.

Of late years many attempts have been made to bring into line the two great industries of gas making and furnace coke production (both dealing with the destructive distillation of much the same class of coal); but in most cases a lack of appreciation of the principles underlying the complex actions taking place during carbonization has proved an obstacle to any important advance—each industry viewing the problem from its own particular standpoint, and failing to grasp the wide differences existing between substances made as the result of a process designed for their special production and the same bodies when they are made as a bye-product.

Furnace coke, as an example, must have certain characteristics to fit it for metallurgical work, which cannot be obtained in the ordinary processes of making good illuminating gas; while if the gas is to satisfy the parliamentary requirements laid down for most large town supplies, it is useless to expect to obtain the same volume of it from a coke-oven that you would from a gas-retort. So that while the gas manager hankers after the economies incidental to carbonization in bulk, he is constrained to work with much smaller charges in order to obtain the necessary quality and quantity of gas; and although he uses temperatures quite as high as the coke-oven manager, he misses the factors of time and mass that are necessary for a good furnace coke.

The Transition Period of Carbonization.

The gas industry is at the present time in the throes of a transition in methods of carbonization—a revolution having been caused in the older forms of procedure by the lowering of the standard of illumination on the one hand, and the introduction of vertical retorts and new ideas on carbonization on the other. The lot of the gas manager who has to decide between the rival use of full charges and horizontals as compared with intermittent and continuous vertical and chamber processes, with nothing but the published figures to guide him, is a most unenviable one; and my desire in the present lectures is to review the existing conditions of carbonization, the principles which underlie the actions taking place, and the direction in which to work to obtain the nearest approach to ideal results.

Before it is possible to explain the highly complex actions taking place in the destructive distillation of coal, it is important to have some definite idea of the nature of the raw material with which we have to deal; and although many attempts have been made to gain an insight into the composition of coal, the wide variations in its characteristics, the difficulties attending any attempt to separate its constituents, and the ease with which the products of its decomposition undergo secondary changes at the temperatures employed in breaking it up, have prevented any very satisfactory solution of the problem being arrived at.

Origin of Coal.

The one thing generally admitted is that coal is the fossil remains of a vegetation that flourished in the carboniferous period of the world's history, and that it has passed through successive stages of checked decay; the action of time, temperature, and pressure, generally out of contact with air, resulting in the conversion of these into the tertiary coals (such as brown coals or lignites), and probably by a continuance of the action yielding eventually the true coal.

In a previous course of Cantor lectures, I went into that wonderful cycle which in Nature purifies the atmosphere by utilizing the waste products of life and decay—water vapour and carbon dioxide—as the food on which the vegetable kingdom is reared, and showed that, under the influence of the sun's rays, the growing plant built up its tissue from the carbon, hydrogen, and oxygen of these bodies, at the same time rendering latent and storing the solar energy in the compounds formed, and that these, converted by time, temperature, and pressure into coal, after countless ages yield back on combustion the heat that was derived from the prehistoric sun.

So far all authorities are agreed; but the changes which take place in the conversion of the plant material into the coal, and the nature of the compounds present in the various kinds of coal, which give this body its widely diverging characteristics, still remain unsolved in spite of the century of work which has been expended on it, and the fact that it has been attacked from almost every point of view. The chemical theories that have been brought forward nearly all start with the assumption that the original material from which the coal has been formed is $n(C_6H_{10}O_6)$—an empirical formula which represents the class of bodies known as "celluloses," and in which the ratios of the atoms lend themselves to an easy explanation of the formation of various kinds of coal by the subtraction of various proportions of the known gaseous products of the checked decay taking place in the formation of peat, lignite, and coal—*i.e.*, methane, carbon dioxide, and also water.

Some theorists have held that the infiltration of water holding oxygen in solution was responsible for actions which, leading to the evolution of these compounds, have resulted in the concentration of the carbon; others have looked upon the action as one of dehydration. Both are probably right to the extent that the conditions under which coal has been formed are so various that cases could be found to support either theory. Moreover, such theories are rendered invalid by the fundamental errors of supposing that Nature is dealing with purified cellulose, and that the various coals are definite compounds that can be represented empirically by a formula. Our only knowledge of the coal plants is derived from their fossilized remains; and owing to the complete nature of the destruction that has taken place in structure, the evidence to be obtained is small indeed. But although of a totally different and far more simple form, it must be that the plant life of the carboniferous period which gave rise to our coal deposits varied as much in character as does the sphagnum of a peat bog from the timber of a forest.

Although the vegetable fibre of all forms produced by plant life contains cellulose, they also contain ligno-cellulose and other allied compounds, while they vary in the extractive matter of their sap to a very great extent. So that even supposing they all underwent the same treatment as regards time, temperature, and pressure during their conversion into coal, we should expect wide differences in composition in the coal formed; while as the conditions vary even more than the material dealt with, it is small wonder that great differences are found between coals from every separate seam in a colliery, and even between different parts of the same seam.

Impossible as it is to give accurate explanations of changes such as those taking place under conditions of which we know only the general trend, and in material the composition of which is of the most variable character, we are met by the further difficulty that, when we have the coal itself, its refractory behaviour towards solvents and any ordinary reagents prevents our learning much more about its constitution than can be given by an ultimate analysis giving its percentage composition, or approximate analysis showing the effect upon it of heat in causing it to yield fixed carbon, volatile matter, ash, and moisture. It is quite clear that, in our present state of knowledge, all that is possible is a generalization based upon the known facts; the truth or otherwise of the theory being shown by how far it is in accord with the observations made in practice upon the results yielded by destructive distillation.

Twenty years ago, I came to the conclusion that the most satisfactory view to take of the composition of coal was that it consisted of an agglomerate of the solid degradation products of vegetable decay, together with such of the original bodies as had resisted to a greater extent the actions to which it had been subjected; and all the experience of wood peat and coal carbonization which I have had since, confirms me in the opinion that this is in the main correct. All the plants of which we have fossilized record in our coal measures consisted of sedges and reeds, tree ferns, club mosses or lycopodia, and trees akin to the pine; but in those prehistoric days the conditions of growth—warmth, moisture, and carbon dioxide—were such that these plants grew with a succulent freedom and rapidity unknown in latter days, and which rendered their tissues an easy prey to decay and fermentation—actions which left only the more resistant unchanged. The work of Morris, Carruthers, Fleming, and Huxley has shown us that the bituminous matter in coal is largely derived from the spores of fossil mosses akin to the lycopodia. If we take the club mosses of to-day, we find their spores give us the body known as lycopodium—a substance so resinous in its nature that it resists the action of water, and is used to coat pills, while the same resinous characteristics render it so inflammable that a little blown through a flame provides the theatrical world with its artificial lightning. Spores of this character, from the giant growths of the carboniferous period, together with the more resinous portion of plants akin to the pine, are the substances which have best resisted the actions taking place during the ages that have elapsed in the formation of coal.

Changes Taking Place in the Formation of Coal.

Our knowledge of the constituents entering into the multitude of changes taking place in the formation of coal is restricted to carbon, hydrogen, and oxygen. But it is improbable that the mineral constituents of the sap and fibre of the original vegetation play any important part in the actions that lead to the change; as although the reduction of sulphates to sulphides, and the combination of the sulphur with iron from the surrounding soil to form pyrites and organic compounds containing sulphur, and the deposition in the mass of other water-carried salts, all tend to the production of the ash of the coal, they do not affect the carbonaceous material in its main changes. In the same way, nitrogen compounds (which are found in every fuel of vegetable origin) are present in all stages of the formation from peat to coal. But it is impossible to suppose that they play any part in the change; while water, although it is probably an active factor and also a product in the decompositions, cannot be taken into account in considering the actual course of the changes from analyses of the body

produced. Hence, in tracing the probable course of the degradation of the vegetable matter through its various stages, it is better to ignore all such factors, and deal only with the variations of the carbon, hydrogen, and oxygen in the material.

Starting with the fibre of the original plants, we find two well-defined bodies—cellulose, as represented by cotton fibre, and lignose, as represented by jute fibre. In the former, the percentage of carbon is 44, in the latter 47—each giving distinctive reactions with dilute acids at 70° C., with anilin sulphate, with Schultze solution, and with mixtures of sulphuric and nitric acids. In the cellular tissue, we find starch; and besides these bodies, there are present the extractive and mineral matters of the sap.

Among the extractive matter we find gums—such as those exuding from the acacia and cherry, but also present in the juice of many plants—mucilage, vegetable jelly (which gives many juices their power of gelatinizing), resins, essential oils, and other well-defined bodies. With some forms of vegetation, the essential oils undergo oxidation and form resins; and these, being more resistant to change, accumulate in masses of decaying vegetable matter, so that large quantities of them are found in lignite beds in a fossilized, but little changed, state.

The changes in the carbohydrates and extractive matters depend largely upon the conditions of decay. Given moisture and air, they become converted into carbon dioxide and water; check the decay by cutting off free access of air, the action is slowed down, and the gases evolved are carbon dioxide and methane.

It is clear that in a mass of rotting vegetation undergoing checked decay, fermentation must play an important part; and Renault found, in an extensive series of researches upon peat, that the most important factor in the conversion of vegetable deposits into peat were fungi and bacterial ferments, which give rise to the production of ulmic compounds of the composition: Carbon 65·31, hydrogen 3·85, oxygen 30·84. Mulder also, at an earlier period, found that bodies could be extracted from peat, to which he gave the name of humic and ulmic acids; and Einof, Proust, and Braconnot found that such bodies formed the chief portion of peat:

	Carbon.	Hydrogen.	Oxygen.	Nitrogen.
Humic acid . . .	60·13	4·74	31·52	3·61
Ulmic acid . . .	62·03	4·65	33·33	—

Herz found bodies of the same character in lignites, which he called carbo-humic and carbo-ulmic acids, of the composition:

	Carbon.	Hydrogen.	Oxygen.
Carbo-humic acid . . .	64·59	5·15	30·26
Carbo-ulmic acid . . .	62·36	4·77	32·87

Fremy also found that not only lignite but bituminous coals could be dissolved in a mixture of mono-hydrated sulphuric acid and nitric acid, giving a dark brown solution, from which an ulmic compound is entirely precipitated by water. Anderson has shown that, by similar treatment, bodies of the same character can be obtained from both caking and non-caking coals.

None of these bodies are probably definite compounds, and resemble the residues obtained by the action of dilute acids on sugar and starch. The evidence, however, seems to point to the presence in all bituminous forms of coal of degradation products of the original vegetation of a humus or ulmic character, and which is probably the portion carrying the nitrogen; and in round numbers the proportions of the carbon, hydrogen, and oxygen will be not far removed from: Carbon 63 per cent., hydrogen 5 per cent., oxygen 32 per cent.

Resin and Other Constituents.

It is also well known that tertiary coals, like the brown coal and lignite deposits, are rich in fossil gums and resins, derived from the extractive matter of the vegetation; and a number of these have been isolated and analyzed. Mulder has found resinous bodies of a similar character in the Friesland peat:

	Source.	Observer.	Analysis. Carbon.	Hydrogen.	Oxygen.	Name.
Peat.	Friesland	Mulder	76·31	10·98	12·71	Beta-resin
(Dark)	,,	,,	78·05	11·94	10·01	Gamma-resin
	,,	,,	79·70	12·15	8·15	Delta-resin
(Light)	,,	,,	75·12	10·21	14·67	Alpha-resin
	,,	,,	79·43	12·54	8·03	Gamma-resin
Lignite.	Saxony	Wackenroder	78·20	12·30	9·50	Cerinin
	,,	,,	81·97	11·47	6·56	Leucopetrin
	,,	Brückner	77·35	10·20	12·45	Georetic acid
	,,	,,	80·27	13·37	6·36	Geomyricin
	,,	,,	78·64	12·70	8·66	Geoceric acid
	New Zealand	Hauer	76·53	10·48	12·80	Ambrite
	Bohemia	Laurentz	81·47	8·71	9·82	Anthracoxen
	Moravia	Schrotter	80·40	10·68	8·74	Retinite
		Mean . . .	78·65	11·36	9·88	

It will be seen that the products from the lignite differ but little from Mulder's peat resins; while it is interesting to note that in the lignite beds of Saxony layers of opaque, yellowish brown matter are found (the pyropissite of Kenngott) which yields up to 62 per cent. of paraffin on distillation, and is the body from which Wackenroder and Brückner extracted their resins. It is evident that in coal there are resin bodies of this character approximating to the general composition: Carbon 79 per cent., hydrogen, 11 per cent., oxygen 10 per cent.

The amount of resin constituents in the original vegetation, and which concentrates itself in the coal, must play an important part in chemical changes taking place during the formation and ultimate composition of the coal; and it is clear that although the vegetation that flourished in the coal age was of a very different character from that of later periods, yet in all probability the variations in the extractive matters of the plants varied to much the same extent as in the flora of to-day. Thus some deposits would be formed from vegetation containing but little of the resin-forming constituents, while others would be rich in them. We know the wide differences there are in the physical characteristics of the lignites—sometimes more like wood than coal, at others black, shining, and with a conchoidal fracture; these variations in appearance being due to the conditions under which they have been formed and the amount of resin constituents present.

If we start with the humus and resin constituents as they exist in the peat deposits of to-day, the latter are present only to the extent of 5 to 10 per cent.; but in the decaying vegetation of the carboniferous age, they were probably present in much larger quantities. The humus, unprotected by it, rapidly undergoes decomposition, with concentration of carbon and evolution of methane, carbon dioxide, and water. As the layers of deposit above the carbonizing mass grow thicker, so probably the temperature rises. The ratio of resin constituents increasing in proportion binds together the mass, and so helps to protect the remaining humus; and with the lapse of centuries lignite is formed. If the amount of resin constituents has been small, or, owing to local circumstances, has not been distributed evenly throughout the mass, the lignite is loose in structure, and during the ensuing ages continues decomposing until, if the pressure has been great and the temperature high, nothing but the residual basis and trace of resin constituent are left in the form of steam coal or anthracite. Under other conditions they may remain mixed with the bituminous coal in a seam and form the "mother of coal."

If the percentage of resin bodies has been very high—as in a drifted deposit of spores from lycopodia—and the temperature has been high, the resin bodies may become semi-liquid, and, mingling with surrounding earthy deposits, will give such compounds as boghead cannel, the organic matter in which has the same composition as resin, while it yields 33 per cent. of ash. Some of the cannels, however, are simply very rich bituminous coals. When the temperature has been high enough, some of the resin constituents practically distil into the underlying clay, yielding some forms of shale.

Heat also may cause isomeric and other changes in the resin bodies, thus altering their behaviour towards solvents; while the effect of heat under pressure upon the resins is in some cases to decompose them, with formation of hydrocarbons, a long series of which were isolated by Renard—among them being both saturated and unsaturated groups, together with hydrocarbons containing oxygen. Hydrocarbons, like retene ($C_{18}H_{18}$), have frequently been isolated; and this body is found in many lignites. Within the last few months, Pictet and Ramseyer have isolated hexa hydrofluorene ($C_{13}H_{16}$) and others of the hydro-aromatic hydrocarbons from coal—bodies which are resolved into aromatic hydrocarbons and hydrogen on destructive distillation. Renard long ago isolated not only saturated hydrocarbons like pentane and hexane, but also hexahydrides or naphthenes isomeric with the ethylene series, from the resin oil obtained by distilling wood resin at a low temperature (350° C.); among these hexahydrides being C_7H_{14}, C_9H_{18}, and $C_{10}H_{20}$. The presence of bodies of this character in low temperature coal tar is a further proof of the presence of the resin bodies in coal.

All these degradation products of the original vegetation are to be found in the bituminous coals, the residual body and humus forming the basis, which is luted together by the hydrocarbons and resins; and the characteristics of the various kinds of coal are dependent upon the proportions in which the four groups of the conglomerate are present. These constituents of the coal have their own characteristic products of decomposition when the coal is subjected to carbonization. The humus bodies during carbonization yield a large proportion of the gaseous products, and under the influence of heat show no sign of melting, but begin to break up at about 300° C. The decomposition becomes more rapid as the temperature rises. Water distils over in the early stages; the tar is thin and poor in quantity; and the gases up to 600° C. consist of hydrogen, methane, and carbon dioxide, with smaller quantities of carbon monoxide and traces of other saturated hydrocarbons. The decomposition can be completed below 800° C.; but if the temperature is run up to 1000° C., the carbon dioxide is reduced in quantity by the action on it of the red-hot carbon. Carbon monoxide increases correspondingly; while hydrogen and methane are still evolved.

The decomposition of the humus is also largely affected by the rate of heating. If slowly heated, a large proportion of the oxygen is given off in combination with hydrogen as water vapour; while if quickly raised in temperature, more combines with carbon to form carbon dioxide and monoxide. The residue shows no sign of caking, while, like the naturally-formed residue—mother of coal—it requires a large proportion of cementing material to make the particles cohere. The resin bodies and hydrocarbons which form the cementing portion in the coal melt between 300° C. and 320° C.; and if a coarsely powdered sample of the coal becomes pasty or semi-fluid at this temperature, it is a strong inference that the coal will coke on carbonization—a fact noted by Anderson, and which I have found very useful in practice as a rough test. About these temperatures also the resin bodies and hydrocarbons begin to decompose.

The resin bodies at low temperature yield saturated hydrocarbons, unsaturated, chiefly hexahydrides or naphthenes, together

with some oxygenated compounds; while the hydrocarbons yield paraffins and liquid products—all these primary constituents undergoing further decompositions at slightly higher temperatures. The liquids so produced begin to distil out as tar vapours and hydrocarbon gases, and leave behind with the residuum pitch, which at 500° C. forms a mass already well coked together if the residuum from the humus is not too large in quantity. The coke formed at this temperature is, however, soft; but if the heat be raised to 1000° C., the pitch residue undergoes further decomposition, yielding gas and leaving carbon, which binds the mass into a hard coke.

It has been shown by Muck and other observers that it is not always the coal containing the largest amount of volatile matter that evolves gas most rapidly or is richest in hydrocarbons; and this naturally follows from the fact that the coals which have the highest oxygen percentage are mostly those giving high volatile matter. As these are rich in the humus bodies which yield most of the diluting gas and but little tar or rich hydrocarbon gases, they cannot give the high result of a coal in which the oxygen content is about 10 per cent. or rather lower, and which contains a large percentage of resin bodies.

Observers have differed as to the nature of the binding material in coke—some holding that it was the residuum of the semi-fused constituents of coal; while others (chief among whom was Wedding) consider that it is carbon shed off by the decomposition of heavy hydrocarbon vapours, which is undoubtedly the cause of the carbon hairs found in coking. My own opinion is that the cementing material is due to liquid products, the most volatile of which go off as vapours, leaving pitch, which carbonizes and binds the mass into coke; and in considering the actions taking place during carbonization, ample proof of this will be adduced.

It is clear that the binding material is formed below 450° C., as if we take a good coking coal and carbonize it at 450° C. we obtain coke, which, although not strong, is perfectly luted together. If we now powder this low-temperature coke and again carbonize it, a large yield of poor gas is evolved; but no coking of the residue takes place. There is no doubt in my mind that it is the resin bodies and their derivatives, the hydrocarbons in the coal, that form the tar, which yields the pitch which lutes the coke, and also that the resin bodies play a very important, if not the chief, part in the weathering of coal.

Effect of Weathering.

Experience shows that the weathering of coal is a phenomenon which is dependent upon the absorption of oxygen from the air; and this weathering is fatal to the coking of some coals, the slacks of which are so susceptible to oxidation that a few days' or weeks' exposure destroys their coking power. Now the avidity of oxygen for some vegetable resins is well known; the rapidity with which copal will absorb oxygen from the air may be taken as an example. Common resin has itself been formed by the oxidation of turpentine, and countless ages under conditions tending to reduction may well have whetted anew the resinic appetite for oxygen. In any case, the resin bodies are the compounds present in the coal most likely to possess this property; and it is the chemical actions so caused which lead to slow combustion and, when accelerated by any rise in the surrounding temperature, is capable of generating sufficient heat to lead to the spontaneous ignition of masses of broken coal large enough to prevent the escape of the heat as it is developed.

Coal exhibits, to a lesser extent, the same property of absorbing gases that charcoal does. The least absorbent will take up one-and-a-quarter times its own volume of oxygen; while many bituminous coals will absorb more than three times their volume of the gas. This action, at first largely physical, presents the oxygen in a probably active condition to the resin bodies in the coal, and leads to the rapid "weathering" and destruction of the coking properties found with some kinds of coal.*

Boudouard has shown that when coal is weathered humus bodies are produced and the coking power is lessened or destroyed. In seven samples of various coals, the humus constituents were increased by the oxidation, which seems to show that the action of the absorbed oxygen is to attack the resin compounds; and as we know that carbon dioxide and moisture are the chief products of the earlier stages of heating of masses of coal, it seems probable that the result is a conversion of resinic into humus bodies with evolution of these gases. It is this change that leads to the serious deterioration in the gas and tar made from coal which has been too long in store; while the fact that a cannel coal like boghead or a shale does not weather, is partly due to its dense structure, and also, in the same way, is an indication that the resin bodies of which it is chiefly composed are of a different type—a fact borne out by their resistance to certain coal solvents which freely attack the ordinary resin matter. The lines of research intended to throw light on the composition of coal have been either to distil the coal at various temperatures, and to draw inferences from the products as to the nature of the original substance, or to directly attack the coal by means of solvents.

The Action of Solvents.

The early attempts to isolate definite bodies from coal by solvents were none of them very successful. Ether, alcohol, petroleum ether, and benzol proved to have but little solvent action; while Guignet succeeded in extracting, by the use of phenol, a small quantity of a brown amorphous body from a bituminous coal, but did not identify it. In 1894, Professor Bedson reported to the British Association the results of a long series of experiments, in which, besides these solvents, he also tried acetic anhydride, glacial acetic acid, turpentine, and anilin (the latter solvent proving the most successful), extracting from the coal a body of the same character as that obtained by Guignet, which, when treated with benzene and ether, yielded on evaporation bodies of a resinous character. He also found that when finely divided coal is suspended in boiling water and permanganate is added, oxidation of some constituents of the coal ensues, and a dark brown alkaline liquid is formed.

In a further report in 1896, he gave the results of acting upon coal with hydrochloric acid and potassium chlorate, and showed that chlorinated compounds are formed of the same character as those obtained by Cross and Bevan from jute fibre. Bedson made a great advance in this line of research when, in 1899, he pointed out the solvent power of pyridine bases extracted from coal tar, which dissolved 16 to 18 per cent. of a Durham coal, but had no action on anthracite.

In 1901, Baker experimented upon the action of this solvent on several coals. He found that from Durham coal (Hutton seam) 20·4 per cent. could be extracted with pyridine, and that after extraction the residue had lost the coking properties of the original coal. This observation was confirmed by Anderson and Henderson in 1902, who tried the action of pyridine in a research upon the coals of Bengal and Japan, and also upon some Scotch coals the coking powers of which were known. They found that the extraction of a strongly coking coal by pyridine weakened the coke, while with inferior coking coal the property is entirely destroyed.

In 1908, Professor Bedson* read a paper before the Society of Chemical Industry, in which he gave the results of experiments upon six coals obtained from the Redheugh Gas-Works, which seem to show that with some gas coals an amount equal to practically the whole of the volatile matter capable of being driven off by heat can be extracted by pyridine.

	Volatile Matter Per Cent.	Pyridine Extract Per Cent.	Gas-Works Yield Per Ton.	Candle Power.
I.	34·10	32·36	11,381	16·63
II.	33·28	35·59	11,392	16·50
III.	31·91	24·58	11,646	16·40
IV.	31·70	22·81	11,108	16·00
V.	33·65	29·97	10,913	16·39
VI.	30·87	22·53	10,730	15·76

Now from these figures the inference is that in a coal like No. II. everything beside the fixed carbon and ash has been dissolved—that is, the humus, resin, and hydrocarbon bodies—and it would have been of the greatest interest had Professor Bedson made an analysis of the residue, or at any rate had shown that no volatile matter was left in it. I have never had the good fortune to obtain a coal from which the pyridine extracted a percentage equal to the volatile matter as given by analysis, even after much longer periods than those utilized by Professor Bedson; but such a coal offers a most valuable field for further examination.

The humus bodies in coal are by far the most resistant portion of the volatile matter to the solvent action of the pyridine, and are practically insoluble. But there are also undoubtedly some forms of resin constituents in coal which are nearly insoluble. Bedson found that the volatile matter in cannel coal varied very much in its solubility, while the hydrocarbons in shale were insoluble; and yet the destructive distillation of these bodies shows them to be very rich in resin constituents. It appears probable that in a feebly coking coal the coking property is due almost entirely to the soluble form of resin constituent, and can therefore be entirely removed by extracting the coal with pyridine; while, on the other hand, in strongly coking coals the property is due partly to soluble resin bodies, but to an even greater extent to other hydrocarbons of resinic origin which resist the solvent action of the pyridine, so that the coking property is weakened but not entirely destroyed by extraction.

A similar conclusion was arrived at by Anderson and Roberts in 1898, from an entirely different point of view. Dr. Percy, more than fifty years ago, pointed out the fatal effect of weathering upon certain coals and slacks, and showed that if a fairly good coking coal was kept at a temperature of 300° C. for a few hours, and was afterwards heated to redness, it does not swell and coke. Anderson and Roberts, in trying this with various Scotch coals, found that, although it was true for a coking coal of medium power, a really strongly coking coal had the power only weakened; and they found also that the same phenomenon could be brought about by treating the two coals with sodium hydrate. The conclusion is that, although resinous bodies which can be saponified or oxidized contribute largely to the coking, yet there are also present non-saponifiable bodies which, in breaking up under the influence of heat, yield enough luting to form coke; and I think the action of pyridine shows that this non-saponifiable body or bodies consist of substances very probably akin to those found in shale and some cannels.

Burgess and Wheeler,† in a paper read before the Chemical Society this year, took a Silkstone coal containing 33·4 per cent. of volatile matter, and succeeded in extracting 30 per cent. by means of pyridine—leaving a coke-like residue, which on distillation at 900° C. yielded hydrogen and oxides of carbon (they would have found methane as well if they had looked for it); while the extract on destructive distillation yielded a mixture of the paraffin

* "Journal," Vol. CI., p. 627. † "Journal," Vol. CXIV., p. 667.

hydrocarbons and hydrogen. At first sight this looks as if pyridine was a solvent which could be used to separate the humus and resin constituents. Messrs. Burgess and Wheeler, however, are careful to point out that "they hesitate to identify absolutely the paraffin yielding constituents of coal with that portion extracted by pyridine." And they are wise in being cautious, as there are several anomalies to be cleared up. I have found several times that after extraction the residue contains as much and sometimes more volatile matter than the original coal, in spite of repeated washings with acid, drying in vacuo, and other forms of treatment intended to eliminate all pyridine; while the composition of the extract also shows anomalous results. After the most careful measures have been taken to free it from pyridine, it will sometimes still contain more nitrogen than did the original coal.

It is to be noted that so far the two most successful coal solvents have been anilin and pyridine (both of them alkaline organic bases); and as we have seen that the effect of extraction by pyridine has been the same upon the coking power of the coal as treatment with sodium hydrate, which saponifies the resin constituents, it seems highly probable that the pyridine forms a compound with the resin constituents, or some portion of them. This compound is soluble in excess of pyridine; and if this is so, it should be traceable by the presence of nitrogen in the extract.

In an experiment made by Baker, he treated coal from the Hutton seam with pyridine. After carefully freeing the residue and extract from pyridine, he analyzed them, with the following results:

20·4 per Cent. Extracted.

	Original Coal.	Residue.	Extract.
Carbon	80·82	82·06	79·37
Hydrogen	4·66	4·85	5·79
Oxygen	10·81	9·65	10·73
Nitrogen	1·84	1·78	2·66 (?)
Sulphur	1·84	1·23	1·40

He queries the nitrogen in the extract, evidently thinking it a mistake.

Anderson also analyzed a Bannockburn main coal, and the matter extracted from it by pyridine:

12·6 per Cent. Extracted.

	Original Coal.	Extract.
Carbon	86·70	83·39
Hydrogen	5·38	6·05
Oxygen	5·94	7·30
Nitrogen	1·98	2·86

In each case there was a large increase in the nitrogen. Baker's analysis of the residue shows that it did not come from the coal; and the probabilities are that the extract is a feeble compound of the resin body and pyridine. In the case of the Hutton coal, the coking power was destroyed by extraction; and in the case of the Bannockburn coal weakened. The extracts, when distilled, gave very large volumes of rich gas, and left a strong but intumescent coke. The residues, after extraction, show a still more remarkable anomaly. As it is manifestly the resin constituent which has been extracted, one would expect that, on determining the volatile matter in the residue, it would be found to be as much lower as the amount extracted; but it proves to be nearly as high as, and in many cases higher than, in the original coal.

Anderson and Henderson, in their examination of coals by pyridine, give the loss of weight of the residues from the extraction on heating, which are here contrasted with the original volatile matter in the coal:—

Volatile.	I.	II.	III.	IV.	V.
In original coal	31·98	39·89	46 59	27·4	36·78
In residue	39·26	44·14	49·14	29·6	43·02
Per cent. extracted	10·8	7·0	21·7	12·8	14·5

This increase in the amount of volatile matter present in coal can mean only that the pyridine has attached itself to some constituent in the coal to form a compound insoluble in excess of pyridine; but the only analysis published of a residue with the percentage of nitrogen determined (Baker) shows no sign of this, as the nitrogen is the same as in the original coal. The volatile matter in the residue, however, is not given.

In an experiment upon a Durham coal (Londonderry) made in my laboratory, the following results were obtained. The coal lost 18 per cent. of its weight to the pyridine.

	Original, Ash and Moisture Free.	Residue from Pyridine.	Pyridine Extract 18 Per Cent.
Carbon	82·87	79·15	81·04
Hydrogen	5·57	4·71	7·18
Oxygen	8·72	14·00 +	7·98 +
Nitrogen	1·68	2·14	3·80
Sulphur	1·16	not determined	not determined
Fixed carbon	63·00	64·46	,, ,,
Volatile	37·00	35·54	,, ,,

+ Oxygen *plus* sulphur.

In this determination, the increase in nitrogen over the amount present in the original coal in both residue and extract points to the presence of compounds of pyridine in both; while the increase in hydrogen in the extract, taken in conjunction with the decrease of hydrogen in the residue, points to its having been a resin body that was dissolved.

These considerations seem to make it clear that the resin constituents condition the coking of coal during destructive distillation, and that they are of at least two kinds—the one easily oxidizable, soluble in pyridine and saponinable by alkalies, and which, on weathering, is oxidized into a humus body with evolution of water and carbon dioxide, and is responsible for the heating of coal; the other class non-oxidizable, not saponified by alkalies, and forming, with pyridine, a compound insoluble in excess of the reagent. This class may be the hydrocarbons from decomposed resins, as the residue in which they are present yields rich liquid hydrocarbons, as tar and pitch, but not rich gas.

My own opinion is that, although pyridine is a better solvent for coal than any other of which we know, it will never prove more than a useful first step in the separation and identification of the complex mixtures present in the coal; while even then pyridine has an awkward knack of attaching itself to other molecules, which makes it difficult to get rid of without using such drastic measures as are quite likely to alter the nature of the bodies dissolved in it. Several observers are at work upon the problem; and it is to be hoped that satisfactory results will soon throw light upon this complicated subject.

Coal always contains a certain proportion of water, which appears to be partly mechanically held and partly in some form of combination; and in this it resembles wood, which, after long air-drying, still retains an average of 20 per cent. of moisture, which, if got rid of at an elevated temperature, is reabsorbed from the air. The mechanically held portion in coal is generally known as "pit water," and represents ordinary wetting, which can be got rid of by air drying. But the so-called "hygroscopic water" is driven out only by drying at 105° C. As this heating for some hours causes oxidation of the resin bodies, it also tends to destroy the coking properties of the sample—a result which has led some observers to conclude that hygroscopic water is essential to coking, which is manifestly incorrect, as the tertiary coals, which contain the largest quantity of hygroscopic moisture, will not coke, owing to the proportion of humus derivatives being largely in excess of the resin bodies.

We have already seen that the ash of coal represents mineral constituents present in the sap of the original plants, or derived from the surrounding strata during the formation of the coal; while nitrogen, derived from the proteid bodies in the vegetation, is always present to the extent of 1 to 2 per cent., and is probably mostly borne by the humus bodies in the coal, which also are the most likely to be the carriers of the organic sulphur which has been clearly proved to be present. The bulk of the sulphur, however, is in the form of pyrites produced by sulphides from the reduction of mineral sulphates reacting upon the iron salts in filtrating in solution into the coal measures.

Classification of Coal.

Many classifications of coal have been suggested, some based on their chemical, some on their physical, and others on their coking properties. Of the latter, the most generally adopted is that suggested by Gruner, in which he tabulates bituminous coals into five classes. Although Schondorff, Muck, and others have shown that it is not applicable to all kinds of coal, still this criticism applies to all classifications that have been proposed.

		Carbon.	Hydrogen.	Oxygen.
1. Dry coal	Long flame and non-coking	75-80	4·3-5·5	13·0-18·5
2. Fat gas coal	Coke porous and brittle	80-85	5·0-5·8	10·0-13·2
3. Semi-fat or furnace coal	Good coke, but porous	84-89	5·0-5·5	5·5-10·0
4. Coking coal	Best coke	89-91	4·5-5·5	4·5- 5·5
5. Lean coals and anthracite	Non-coking	90-93	3·0-4·3	3·0- 4·5

This arrangement shows not only the coking properties, but also the changes in composition which the coal undergoes, the concentration of carbon, and reduction in highly oxidized bodies. In the first class, we have the dry coals, yielding large volumes of gas and liquid products on distillation; and these—as might be expected—most resemble the lignites, and share with them the property of non-coking or binding together of the residue on carbonization. This is due to the fact that the humus-like bodies are still present in much larger quantities than the resinic compounds and hydrocarbons; and as on distillation they leave no binding material in the residue, the resinic bodies cannot supply enough to give more than a friable mass.

In the second class of coals, altered conditions of temperature, pressure, and time have led to further decompositions of the humus bodies; and the resinic constituents and hydrocarbons having increased in ratio by concentration, a point is reached at which coking takes place, although not of a really satisfactory character.

In the third class, the action has still continued with further concentration of the resin bodies, hydrocarbons, and residuum, with the result that the former bodies are so increased in comparison to the humus and residuum that a good coke results, although, for reasons that will be discussed when speaking of coking processes, it is rather too porous and bulky.

In the fourth class, the proportion of resin and hydrocarbon bodies has reached the right ratio as compared with the humus and residuum, and the best coking coal is obtained. Bituminous coals of the kind classified by Gruner may therefore be looked upon as an agglomerate of humus and the degradation products of these bodies down to carbon, luted and protected by resin bodies and their derivatives; steam coal and anthracite as the degradation products of humus which has nearly completed its decomposition owing to the small quantity of resin bodies in the

original vegetation; cannel coal, as consisting mainly of resin bodies, which, having been in a semi-fluid condition, have mingled with the earthy matter in contact with it, so obtaining the high ash found in many kinds.

In putting forward this theory as to the composition of coal, I wish it distinctly understood that by the terms "humus" or "resin" bodies I do not imply any one definite compound, but merely bodies of this character—the humus bodies all containing a percentage of hydrogen from 5 per cent. downwards, while the resin bodies all contain a percentage of hydrogen above 5 per cent. If it is once admitted that coal is a conglomerate of the kind I have indicated, it explains all those obscure points which no other theory touches—such as why with two coals of almost identical composition and of high oxygen content, one should be a coking and the other a non-coking coal; the reason being that in the one the high oxygen content is due to humus bodies, which will not coke owing to the low pitch-forming nature of the hydrocarbons, while with the other the oxygen is due to resin bodies, which are essential to good coking.

In 1898, Anderson and Roberts, as the result of a long research upon the chemical properties of Scotch coals, came to the conclusion that a considerable part of the organic matter in coal consists of a complex compound comparatively rich in nitrogen and also containing sulphur, and that there is also present resinous material, while the remaining constituents are composed of degradation products of the original carbo-hydrates of the coal plants—a theory which in its essentials agrees very well with my views on the subject.

Distillation at Various Temperatures.

During the present year, Burgess and Wheeler have published the results of a series of experiments upon the distillation of coals at various temperatures, which lead them to conclude that coal contains two types of compounds of different degrees of ease of decomposition. The more unstable decomposes below 750° C., and yields on distillation the paraffin hydrocarbons and no hydrogen; the other decomposes only at or above 750° C., and yields hydrogen only, or possibly hydrogen and oxides of carbon. The latter they suppose to be a degradation product of cellulose; the former to be derived from the resins and gums from the coal plants. The authors consider that the difference between one coal and another is determined by the proportion in which these two types exist in the coal.

In 1907, while working on the "Coalite" process, I found that the possibility of making this smokeless fuel was dependent on the fact that if the temperature of distillation of a coal was kept at 400° to 500° C., all the liquid and all the heavy hydrocarbon products of its decomposition capable of forming smoke were evolved (the volume of gas amounting to from 4000 to 5000 cubic feet), while the coke still contained a residual compound that required a temperature of 700° to 1000° C. to decompose it, when a volume of gas nearly equal to the original yield was evolved, consisting of hydrogen and methane with small quantities of oxides of carbon. It was this volatile compound which gave the coalite its ease of ignition and flaming combustion. This I stated in a Cantor lecture at the Royal Society of Arts in 1908 when giving the principle of the manufacture of coalite, as follows: "Success can be achieved only by dropping the temperature to a scarcely visible heat; and when this is done, the coke may be kept at it for almost any period without driving out those volatile hydrocarbons that give easy ignition and a smokeless flame." *

It is evident that this more resistant volatile residue is the body which Burgess and Wheeler consider to be a degradation product of cellulose, which on heating "yields hydrogen alone." The error into which these observers have fallen in supposing that hydrogen alone is evolved, is due to the fact that their assumptions have been based upon the composition of the gases evolved during distillation at successive stages of temperature and the use of very small quantities of material. Had Burgess and Wheeler used a larger quantity of coal, and distilled out everything that would come over up to 600° C., and had then distilled the residue at from 800° to 900° C., they would have found that at these temperatures the residues were still yielding a certain proportion of methane, which had been one of the most characteristic products of decomposition from the time when the vegetation first began its conversion into peat. Another great mistake made by Burgess and Wheeler lies in supposing that, of the two classes of compounds present in coal, one decomposes below 750° C., while the other decomposes only at or above that temperature, and yields hydrogen only.

All the evidence that can be adduced shows that when a coal undergoes destructive distillation all the hydrocarbons, together with the resin and humus constituents, undergo decomposition at a temperature certainly well below 700° C., and that as the liquid and gaseous products distil out they leave behind their less volatile residues as a pitch, which lutes together the carbon particles and forms soft coke; while as the temperature rises above 750° C., the pitch residue decomposes, yielding hydrogen, carbon monoxide, and methane as gases, while the carbon residue from the pitch binds the residual mass into coke. It is this residual pitch that Burgess and Wheeler have mistaken for a primary constituent of coal.

It is clear, however, that (putting detail on one side until our knowledge has been broadened by experience) the answer to the question as to what is the composition of coal—whether the answer is derived from a consideration of the actions taking place during its formation and of the substances from which it was derived, or is obtained from analytical data, as was done by Anderson and Roberts, or from the products of distillation as has been attempted by Burgess and Wheeler—must be that coal is a conglomerate of humus and its degradation products with the resinic bodies and their derivatives.

* "Journal," Vol. CI., p. 825.

ACTUAL LEAKAGE IN UNACCOUNTED-FOR GAS.

By Jacob D. Von Maur, of St. Louis.

[Extracts from a Paper read before the American Gas Institute.]

Judging from the latest reports of the United States Geological Survey, there will be manufactured in the United States during the year 1911 more than 180,000 million cubic feet of gas; and of this amount, approximately 6 per cent., or 10,800 millions, will have been lost by actual leakage, or in other ways unaccounted for. How much this loss amounts to in dollars and cents, depends entirely on the items which go to make up the total of unaccounted-for gas. These items are roughly divided into three general classes: (1) Loss due to actual leakage of gas; (2) losses due to slow or defectively registering meters, or to the temperature conditions under which the gas is measured, &c.; (3) gas unaccounted for owing to methods of accounting. From a financial point of view, the losses due to the second cause are by far the most important, as gas which has been manufactured, distributed, and actually sold represents a loss equal to the selling price of the gas. Losses due to actual leakage, on the other hand, are equal only to the cost put into the gas up to the point of leakage; but, owing to the potential danger of leaking gas, it is of the utmost importance that leakage from this source should be kept to a minimum. The unaccounted-for gas due to methods of accounting includes such items as corrections for gas at the works, differences due to the time of reading meters, &c. It is well to note, in passing, that the increased sales for the last half of December of each year will always appear as unaccounted-for gas in cases where the fiscal year corresponds with the calendar year. It would be better, when considering the unaccounted-for gas, to have a record made for the year ending with the end of the month having the least consumption.

It is safe to say that the money value of the unaccounted-for gas in the United States is between $6,000,000 and $8,000,000 annually—an amount equal to interest on a capital of $100,000,000. How much of this loss is due to actual loss of gas to the company, and how much of it can be saved by improved methods, is more important than the question as to how the unaccounted-for gas can be reduced by different methods of computing it. But if the item "unaccounted-for gas" is to be used for comparative purposes—as, for instance, to determine the relative conditions of various distribution systems—then the methods adopted for ascertaining its value should certainly all be on a similar basis. Unfortunately, this is not the case; so that it is very difficult to obtain a correct idea as to the efficiency of the operation of one company as compared with another, from any published data.

The report of the United States Geological Survey shows that the percentage of unaccounted-for gas is not by any means uniform. In 1907, it varied from 1·6 per cent. in Pennsylvania to 22·7 per cent in Nevada, New Mexico, and Utah; and in 1908 the variation was from 1·9 per cent. in Pennsylvania to 18·4 per cent. in Virginia and West Virginia. But the average for the two years named remained the same—5·9 per cent. Published reports from foreign cities seem to indicate a more uniform method of accounting, and consequently more uniform results. [The author gave a list of various places in Great Britain, showing a range of from 4·8 per cent. (Bradford) to 8·7 per cent. (Glasgow); and another of a number of cities in Germany, showing a range of 1·2 per cent. (Stuttgart) to 13 per cent. (Essen). In only three places, however, out of 47 was the unaccounted-for gas 10 per cent. or upwards.]

The method of reducing the leakage and unaccounted-for gas to a basis of so many thousand cubic feet per mile of equivalent 3-inch main is very objectionable; and, for different reasons, the reporting of this item as a certain percentage of the send-out is very misleading. Dr. A. C. Humphrey, in a paper read before the Institute last year, showed clearly how the public are deceived by misleading analysis of data; and this paper might well be extended to show how gas men are misled in dealing with reports covering data of unaccounted-for gas. As a matter of fact, it is impossible to represent the condition of a distribution system by either of the above methods. One management may increase profits by increasing sales, while the property is allowed to run down; whereas another may neglect the sales, and still make a fair showing by careful and economical oversight of operations. But good management should combine the advantages of careful operation with those of an energetic commercial policy.

I wish particularly to emphasize the fact that, in dealing with actual leakage from mains and services, there is no connection between the amount of gas sold and the actual leakage. If the mains and services are simply filled with gas under ordinary distribution pressures, the actual leakage will be the same whether no gas is sold or whether the consumption is 100 million cubic feet per year. We can therefore gain no very intelligent idea as

to the condition of the distribution system by reporting the unaccounted-for gas either on a percentage basis or as unaccounted-for gas per mile of equivalent 3-inch main. The theory at the back of the practice of so reporting leakage is based on the supposition that the actual leakage will be in proportion to the circumference of the joints. No allowance is made for increased leakage due to high pressures used in reinforcing mains, nor is any consideration given to leakage from service-pipes, &c.

Our experience in St. Louis seems to demonstrate that the greater part of the actual leakage does not originate in the joints at all. Leakage is made up of a multitude of very small defects. A leak of 1-40th of a cubic foot per hour, known as a pin-hole leak, cannot ordinarily be detected by the sense of smell, and is very likely to be overlooked in testing joints. If the gas from such a leak could be lighted, it would represent a flame one-fourth the size of the pilot-light of an ordinary mantle lamp. The following table shows the amount of gas that would escape annually at the various rates of leakage per hour given, and also the quantity that would escape from one mile of main per year, if there was a leak at each joint of from 1-40th of a cubic foot per hour and upwards.

Rate of Leakage per Joint per Cubic Foot per Hour.	Equivalent Cubic Feet per Year per Joint.	Cubic Feet per Year per Mile of Main.
1-40th	219	96,360
1-20th	438	192,720
1-10th	876	385,440
1-5th	1752	770,880
0·5	4380	1,927,200
1·0	8760	3,854,400

[The author gave another table showing the total leakage for one mile and for a system of 800 miles at various rates of leakage; also corresponding financial loss and amount of money per mile that could be expended to equal the loss due to escaping gas.]

The following table, taken from the "American Gaslight Journal," is also interesting, as indicating the quantity of gas (in cubic feet) which will pass through small orifices, such as rivet-holes in holders, under various pressure conditions, in the course of a year.

Leakage in Cubic Feet per Year.

Pressure in Inches of Water.	1-16th Inch.	1-8th Inch.	1-4th Inch.
2	58,040	232,228	929,129
4	82,120	328,480	1,314,000
6	100,560	402,320	1,609,200
9	123,200	492,800	1,970,800
12	142,400	569,600	2,376,800
16	264,240	656,800	2,628,000
25	205,200	821,200	3,284,000
	0·5 Inch.	1 Inch.	2 Inches.
2	3,716,520	14,866,200	59,464,800
4	5,256,000	21,024,000	84,096,000
6	6,437,200	25,748,000	102,996,000
9	7,884,000	31,536,000	126,144,000
12	9,116,000	36,456,000	145,828,000
16	10,512,000	42,048,000	168,192,000
25	13,140,000	52,560,000	210,240,000

Causes of Leakage.

Having made all possible correction as to temperature, moisture, pressure, &c., at the works, and taking due account of the condensation, &c., removed from the drips, the unaccounted-for gas will then be made up of the following items:

Class A.—(1) Leaks at lead joints. (2) Leaks at cement joints. (3) Broken mains. (4) Split pipe or bells. (5) Loss of gas at the time of making main connection. (6) Leaks due to electrolysis. (7) Leaks through walls of pipe.

Class B. (*Leaks at Service-Pipes*).—(1) Services rusted through corrosion. (2) Services eaten out by electrolysis. (3) Broken or split fittings. (4) Leaks at stop-cock. (5) Gas escaping at the time of making service connection. (6) Service broken. (7) Split pipe. (8) Services pulled out of main. (9) Leaks at meter or meter connections.

Class C. (*Leaks at Street-Lamps*).—(1) Too early lighting. (2) Too late extinguishing. (3) Excessive consumption of burners over requirements. (4) Broken lamp-posts, causing services to leak. (5) Leaks caused by similar conditions to those in Class B. (6) Leakage of pilot-lights.

Class D.—(1) False connections bye-passing meters. (2) Slow meters. (3) Defectively registering meters. (4) Losses due to temperature effects.

When gas is compressed after having been measured at the station meter and then allowed to expand through street regulating-stations, &c., there will be an additional loss due to water and hydrocarbon vapours being condensed out of the gas during compression. This liquid is pumped from the high-pressure mains, and so is lost to measurement, except such portion as has already been allowed for in the original correction for temperature and moisture.

The Chairman of the Technical Committee asked me to discuss particularly the question of "bottle-tight mains." It is not a specially difficult matter to instal such a system; the trouble arises in keeping the mains so. Before we go too far into the question, however, it will be profitable to examine our standard system, and ascertain just how nearly bottle-tight it is or can be made, and what improvements or changes could be effected, either in methods or materials, in order to reach a higher degree of perfection. By the standard system of main is meant ordinary cast-iron bell-and-spigot pipes, laid with either lead or cement joints, and for illustrative purposes the system in St. Louis may be taken as a fair example.

During the past few years, a very accurate report has been kept of every leak which has been reported in the city; but it must be understood that this does not take into consideration leaks due to electrolysis or corrosion, &c., while actually rehabilitating an entire street, but refers to reported leaks only. It so happens that the greater portion of the soil in St. Louis is yellow clay, which in its undisturbed condition is very nearly gas-tight. We have, therefore, found in our overhauling work many cases of services, &c., eaten out by corrosion or electrolysis, which in less favourable soils would have manifested themselves long before they were actually discovered. Prior to 1903, the distribution system was in a very bad condition, and necessitated a vast amount of overhauling and new work.

[The author gave a series of tables showing the total number of leaks in the old and new work for the period of thirty months prior to Jan. 1, 1911. The amount of new work was about equal to 70 per cent. of the old, or approximately 41 per cent. of the total. The author mentioned that, in addition to this, a large portion of the old work had been rehabilitated during the past eight years. About 80 per cent. of all the mains installed were laid with cement joints, and of late years practically all the joints had been made with this material.]

Dealing with the results shown in the tables, the author said: There is very little danger indeed from broken mains 6 inches and upwards in diameter, when properly laid. It is evident that the trouble from broken mains is almost entirely confined to the 4-inch size and under. As a matter of fact, in the years 1903 and 1904, we had as many as thirty 3-inch mains broken in the single month of January. The deduction to be drawn, therefore, is that if a main system is made up of cast-iron bell-and-spigot joints from 6 to 30 inches diameter, there is practically very little danger of escape of gas from broken mains, and consequent leakage due to this source. Low-pressure mains of all sizes, from 4-inch upwards, can be put down with practically no risk of excessive leakage, if they are well laid and the joints properly made with cement. Even with lead joints, the leakage is not so great as is ordinarily supposed. Sometimes a general condition will cause an entire line to leak at the joints. In one case, there were 130 10-inch lead joints discovered leaking. This main, as laid many years ago, was found to have from 24 to 30 inches of cover, and was located directly under a rail of a street-car track. The lesson to be learnt is that great care should be exercised in selecting the proper location for gas-mains. If there are car-tracks on the street, there should be a main on each side of the thoroughfare as near to the kerb as possible.

When we come to medium high-pressure mains—that is, those worked at from 3 lbs. to 5 lbs. pressure—we find some trouble with leaking joints. In the case of the leaky 16-inch joints shown in one of the tables, the high-pressure main was laid under very bad soil conditions, alongside a street-car track, and parallel to a large water-main; and it never showed any leaks for two years. A sewer was then constructed through the solid rock to a depth of from 10 to 20 feet, alongside the main. It is only fair, therefore, to consider the leaks on this line to be caused by exceptional circumstances. The main laid in the part of the street in which no sewers have been constructed has remained absolutely tight. In the case of the 24-inch high-pressure mains, all the leaks were found on mains which had been laid for six months. Not a single leak developed on tests for the entire distance of four miles. Every pipe was laid on countersunk blocks, so that the leaks were due either to contraction or expansion, or to an inferior grade of cement being used. The deductions to be drawn are that it is possible to make an iron pipe low-pressure system practically bottle-tight, so far as the joints are concerned, provided these are made with cement, and no size less than 6-inch is used. If there is a considerable number of high-pressure mains laid having diameters above 16 inches, there is still some doubt as to the possibility of making these pipes absolutely bottle-tight. Certainly, they can be rendered as tight as where the joints are made with lead, and possibly more so.

The writer had intended to add some data on joints made with lead wool; but it was thought best to leave this matter to be brought out in the discussion. Certain it is that lead-wool joints on low-pressure mains can be made tight, though at a very much increased expense over other materials.

Services will always be broken by contractors working on the street, and there is no remedy except that of vigilance. Defective fittings and pipe form a large portion of the leaks indicated in the tables. Careful inspection will reduce this number to a minimum. Broken and leaking services, caused by lamp-posts being broken by passing vehicles, stand out prominently. There is no way of preventing this; and it is our system to collect damages from the responsible parties, wherever the responsibility can be fixed. The item of "rusted out" or "corroded" services has always been a very large one; and in the opinion of the writer it can never be entirely prevented. But the damage can be much lessened by properly coating the pipe. With regard to leakage caused by split pipes, bells, and service fittings, services pulled out of mains, escapes at meter connections, &c., it will probably be impossible to entirely prevent leaks from these causes; but if the pipe and fittings used are of sufficient strength, and are properly inspected and installed, the trouble can be largely eliminated, and this can only be attained by willingness on the part of the company to pay the bill.

One of the most prolific causes of actual leakage is that due to electrolysis. Much has been written on the subject, and many theories have been advanced. But after one has read and listened to them all, he is as much in the dark as ever as to what practical steps he should take to prevent the damage constantly going on in the particular system over which he has charge.

The writer, while having no theories to advance, feels that if the subjoined rules are intelligently followed, leakage from mains and services due to corrosion and electrolysis, as well as from other causes, will be materially lessened, though the final solution for the prevention of electrolysis must be found by discovering a way by which the railway company must utilize their own property for the return of their currents to the power-house, instead of that furnished by the pipes of the conduit companies. One thing is certain—namely, that nothing thus far has been developed which can be installed at reasonable expense by a gas company to prevent the tremendous damage which is constantly taking place in the destruction of our gas mains and services.

General Rules for Street Work.

The following rules refer particularly to large cities, and are intended to lessen the amount of unaccounted-for gas due to actual leakage. Many of the rules are based on what has already been said in the paper.

1.—Lay no pipe smaller than 6 inches diameter, except in special cases. This will make the bulk of the main system of 6 and 8 inch pipes. All mains to be of cast iron, and at least as heavy as the standard used by the Philadelphia Gas Company.

2.—Use cement joints entirely for all sizes of low-pressure mains up to 30 inches in diameter inclusive. There may be circumstances where this rule will have to be modified. For high-pressure mains, 16 to 24 inches inclusive, cement joints will probably give at least as good results as lead; but these mains must be laid with unusual care. Leaks will probably develop within a year after the main is laid; but after these have been once repaired there will be very little future trouble.

3.—Use full weight wrought-iron or steel pipe, and a comparatively heavy beaded fitting for all service work, coating the pipe with at least four coverings of pitch and paper, or some equally effective covering. The pipes should be left free from covering for a distance of 6 inches from each end, as this will assist in preventing the workmen from damaging the covering while using the wrench. When the service is completed, this part of the pipe should be pitched and papered, in order to make it equally as efficient as the rest of the service. It is good practice to coat the fittings also with pitch, cement, or asphalt at the point where the service joins the main.

4.—All threads should be cut so as not to leave any part of the thread exposed outside the fitting. Experience shows that both electrolysis and corrosion attack this part of the pipe more rapidly than at any other point.

5.—Where there are street-car tracks, a main should be laid near the kerb on each side of the street; and, in the opinion of the writer, nothing will do more to avoid danger by electrolysis than this. But it must be admitted that to do this is to apply a very expensive remedy. Lay no main with less than 3 feet of cover, where the climate is similar to that of St. Louis. On very wide streets, lay a main on each side, close to the kerb. On residential streets, lay either one or two mains, depending on local conditions; but where one main is used, it should be laid with a cover varying from 3 ft. 6 in. to 4 ft. 6 in., depending on the local conditions. On streets where there are two car-tracks, and in which it is desired to lay only one main, this should be laid as near as practicable to the kerb on one side of the street, and with such a cover as will keep the services crossing under the car-tracks a reasonable distance from the tracks.

6.—Lay no mains on ungraded streets unless an exact profile of the future grade of the street is available.

7.—Where there is no kerbing, protect all stop-boxes by means of small pieces of flagging placed round the box. Do whatever is possible to prevent water from reaching the service-pipe outside a service-cock.

8.—Under no circumstances lay a main or service on or through any solid structure, such as conduits, manholes, sewers, &c.; and do not allow others to build these structures on or round mains or service-pipes.

9.—Lay no mains on filled-in ground till it is properly settled. Lay no service-pipe or main in the same trench with any other conduits.

10.—Allow no electric bonding of any kind from any portion of the distribution system to car-tracks or to other conduits.

11.—In filling in trenches, use no material for filling which may have a tendency to corrode the pipe—such as cinders, &c.

12.—Stand for a little greater cost, and lay every main and service as it should be laid—viz., on solid, undisturbed ground; and in the case of the larger mains, use solid blocks countersunk, so that the top of the block is flush with the surface of the ground.

13.—To avoid mains breaking at the service, and services breaking at the main, see to it that the main is properly strengthened wherever the tap-hole may have a tendency to weaken the pipe. Ordinarily this is done by the use of cast-iron split service sleeves, which are expensive; and probably equally good results can be obtained by using sleeves made of cement, which cost, in place, about one-sixth that of cast-iron sleeves.

14.—Finally, have every one in charge of the work fully alive to the fact that he is not building for the day only, but for many years to come. Have a sufficient number of men to thoroughly inspect all work done, and provide these men with the necessary conveniences to enable them to see as much of the work as possible, and thus properly supervise the work.

Even when all these rules, and additional ones equally good, and perhaps better, that may be mentioned by others more capable than the writer in dealing with this problem, are rigidly followed, we shall still have some leakage; but the amount will be confined to very much smaller limits than at present.

[The author next gave a series of tables showing the results of tests of stretches of mains under actual conditions. They covered 10,436 feet of 3-inch, 18,979 feet of 4-inch, 32,239 feet of 6-inch, 3530 feet of 8-inch, and 6720 feet of 12-inch main—a total of 71,904 feet of main and 2037 services, and 306 lamp-services, exclusive of high-pressure main tests. The services measured about 107,961 feet, exclusive of the street-lamp risers. The author remarked that, assuming the tests represented a fair average of the leakage of the whole distribution system, they would seem to indicate a total actual leakage from mains and services in the low-pressure system of approximately 50 million cubic feet per annum, or about 1 per cent. of the output. With regard to the leakage on high-pressure steel or wrought-iron mains operating under 30 lbs. to 40 lbs. pressure, the author stated that in one system, made up of 123 miles of mains and services, varying in size from ¾ inch to 6 inches diameter, a test was made by noting the drop in pressure during the night hours of practically no consumption. The test indicated a leakage of approximately 30,000 to 40,000 cubic feet per mile of pipe per year. But in speaking of leakage from high-pressure mains, he said it was well to bear in mind the fact that while the actual leakage might be high, yet if reckoned on a basis of actual gas passed by these mains, the percentage leakage might be very low if reduced to a capacity basis of pipe delivery as compared with the capacity of low-pressure mains. But the fact must also be borne in mind that the leakage from a cast-iron main would probably remain more uniformly constant from year to year; whereas the wrought-iron or steel pipes would probably leak at a very much greater rate as years rolled by.]

Having discussed the relative merits of wrought-iron and steel pipe, the author submitted the following

Suggestion for a Better Method of Reporting Unaccounted-for Gas.

I think I have shown that the great weakness of the standard distribution systems to-day is not in the cast-iron mains, but in the wrought-iron and steel pipes; and I recommend the American Gas Institute to adopt a new rule for reporting unaccounted-for gas for purposes of comparison.

Since the object of studying the item of unaccounted-for gas is to determine the important questions of actual leakage from the distribution system and unaccounted-for gas due to other causes, the principal of which is defective and slow registering meters, it should be given in such terms as will take into consideration all the factors entering into the problem. Every company should have on record the average percentage of error of meters as they are returned from service. This average test will ordinarily be on the slow side; and the leakage should first be corrected by subtracting from the total unaccounted-for gas the percentage equal to the average percentage of error of the meters as far as it may be known. The leakage as corrected above now more approximately represents actual leakage from the system; and this leakage is not made up entirely from the escape of gas from the mains, but to a greater extent from leakage from service-pipes.

Probably the bulk of the larger distribution systems are made up of 6-inch cast-iron pipe; and it has been shown that this size pipe will probably remain at least as tight as any other size that might be chosen. It is suggested, therefore, that the 6-inch main should be chosen as a standard, and all sizes of cast-iron main larger than this be reduced to a 6-inch basis, and all cast-iron mains less than 6 inches diameter be considered as equivalent to a 6-inch main.

While the cast-iron main will probably only leak at the joints, the opportunity for a steel or wrought-iron pipe to leak is present at every point of the surface of the pipe; and it is important to note that when once the service-pipe is punctured, the opportunity for gas to escape is vastly greater than a joint in a cast-iron main. The weight to give the steel or wrought-iron pipe would depend strictly on the outside area of the pipe; but for practical purposes it is probably sufficient to consider all steel or wrought-iron pipe as so many feet of 6-inch main. The leakage mentioned above should then be divided by the sum of the cast-iron pipe reduced to a 6-inch basis where the diameter is above 6 inches; *plus* the actual cast-iron pipe below the size of 6 inches, *plus* the total length of screw pipe, regardless of its size. While this method of describing unaccounted-for gas is not entirely satisfactory, it at least has the merit of giving weight to most of the important items which go to make up the unaccounted-for gas. If we let

U = unaccounted-for gas (corrected as suggested),
A = length of all cast-iron pipe 6 inches diameter or less,
B = length of all steel or wrought-iron pipe,
C = all cast-iron pipe over 6 inches reduced to 6-inch,

Then the leakage per mile of equivalent 6-inch pipe will be—

$$L = \frac{U}{A + B + C}.$$

Thus far we have only considered that portion of the unac-

counted-for gas known as "actual leakage." We now have to consider the gas lost to the company due to the incorrect registration of consumers' meters. Assuming that the gas has been properly measured and corrected at the works, and that the meter when put into service is in proper condition, the correctness of registration will very largely depend upon the conditions surrounding the location in which the meter is fixed. In this respect gas companies have been very lax, and the comparison of the conditions surrounding the installation of an electric meter with those of a gas-meter would show up very unfavourably to the latter. It is to the interest of all concerned that a gas-meter should be located where it will not be subjected to mechanical injury or to extremes of temperature. As a fact, we find them frequently located under some of the very worst possible conditions.

In these days, when a number of pilot-lights of various kinds are being installed, it is more important than ever that the meter should register on the smallest possible flame. A lamp burning 4 cubic feet of gas per hour for three hours per day will consume 12 cubic feet, and if the pilot burns for the remaining 21 hours, the consumption will be 2·1 cubic feet, or 17 per cent. of the consumption of the lamp while burning. This illustrates the great necessity of keeping gas-meters in the best possible condition.

No mention has been made of steel pipe for mains made up, for instance, like the Mannesmann steel tubes, which I understand are extensively used abroad. The published statements from foreign manufacturers are very flattering, especially when the pipe is covered with Hessian cloth or jute cloth impregnated with asphalt. Nor has any mention been made of the various types of cast-iron pipe joints other than the standard bell and spigot. The writer has confined his observations to, and has dealt only with, facts brought out in actual practice; and these do not show any excessive loss of gas from cast-iron bell-and-spigot joints when the pipes are laid under the conditions under which the writer has had experience.

Actual leakage can best be reduced by improving our service installation, and reducing the number of very small leaks at street-lamp burners, supervising the lighting and extinguishing of the street-lamps, fixing meters in proper locations, and using care in making service and main connections. But the largest item in the unaccounted-for gas account is undoubtedly due to the improper registration of meters, the average tests of which are invariably on the slow side. But this paper attempts to deal only with the part of the unaccounted-for gas which is due to actual leakage in the distribution system.

UTILITY OF DISTRICT HOLDERS.

By R. G. Griswold, of Denver.

[Extracts from a Paper read before the American Gas Institute.]

The district holder may be defined as a holder isolated from the works for the purpose of assisting the distributing system. These holders are quite common in the larger cities; and they may also be found in many of the smaller ones.

That a district holder helps, is proved by the erection of new ones from time to time. It helps just as a works holder aids the works. With the former, only enough gas-making capacity is required to manufacture in 24 hours as much gas as is distributed in that time. Without such a holder, the gas-making capacity required at certain periods of the day would be several times as great as when using the holder. In a gas-load curve taken by the author, it was shown that at about 6 p.m. gas was sent out at the rate of 87,000 cubic feet per hour; but the total output for the day was only a million cubic feet, or an average of 42,000 cubic feet per hour. With the holder, a gas-making capacity of this amount would be ample; but without it the capacity would have to be 87,000 cubic feet per hour.

The same relation will hold good with a district holder. If a certain transmission main must deliver a million cubic feet of gas per day, it would need to have a capacity of 87,000 cubic feet per hour without a holder at the point of delivery, but only 42,000 cubic feet per hour if the holder were provided. In many cases the main is already laid, and the business has increased until it is difficult to keep up good service at the peak of the load. If a holder is installed at the end of the main, more than twice as much gas can be sent through in 24 hours, and still give satisfactory service. It will also be evident that the district holder, or storage capacity in district holders, is of just as much value to the manufacturing capacity as if it was located at the works.

The object of this paper is to advocate that the benefit of the holder should be still further extended to include as much as possible of the distribution system. The ideal arrangement would be a holder on each service, as the entire distribution and manufacturing equipment would then receive the benefit of a uniform load throughout the day. This arrangement will probably never prove practicable, on account of the increased investment and operating expenses; but by grouping these small holders into district holders supplying areas two or three miles square, the cost is reduced so much faster than the benefits that a considerable saving can be made by their use.

A holder on the end of an isolated transmission main augments its capacity. It would increase the capacity if the transmission main were tied-in to the existing mains at every intersecting street, and also supplied services. If this is granted, then when an outlying district begins to tax a distribution system which is without a district holder, one should be erected within the district in question, and joined to the existing mains. These would act as transmission mains between peaks feeding the holder; but during the peak the holder would feed the mains, thereby increasing their capacity several times.

In order to study the possible economies of district holders on the distribution network, the size of the holder becomes of importance. There is a variety of opinion as to the storage capacity required for a given output of gas. In some works it is equal to the maximum day's output, or more; and yet we can all probably recall plants that have not more than 30 per cent., and yet the service was not impaired. With the object of studying this a little more thoroughly, the author has collected a number of load curves from all over the country; the idea being to show as much variety as possible. [The curves were given in the paper.] All the curves represented an output of a million cubic feet per day; so that the average was a little less than 42,000 per hour. When the actual output for any hour is less than 42,000 cubic feet, gas can be put into the holders by an amount equal to the difference between the actual output and the average. On the other hand, if more than 42,000 cubic feet are sent out, the holder will fall, to make up the difference between the actual output and the 42,000 cubic feet. By adding the number of cubic feet put into the holders, and deducting the quantity drawn out interval by interval, other curves were obtained corresponding to the several load curves. The total rise and fall of the holders in the first of the curves was 203,000 cubic feet, or 20½ per cent. of the day's output. This is all the holder capacity utilized. Any more may be useful to the manufacturing plant, as an insurance against lack of gas due to breakdowns, &c.; but it will not be utilized ordinarily. Let us call the part of the total holder capacity actually used (*e.g.*, 203,000 cubic feet in the example taken) the "active" capacity, and the balance the "reserve" capacity. The former varies from month to month, and even from day to day; and as it changes, the latter is, of course, affected. The natural growth of the business also encroaches on the reserve capacity, until sometimes very little of it is left.

Statistics are not at hand, but undoubtedly 99 per cent. of the money invested in the distribution of artificial gas in the United States, excluding services and meters, is invested between the holders and the consumers' premises. Even in plants using district holders at the terminus of the transmission mains, at least 95 per cent. of the investment will be between the holder and the services, and not more than 5 per cent. between the holder and the works. Furthermore, this 5 per cent. never proves so unreliable as to justify any reserve capacity. The maintaining of this in excess of the active capacity may be necessary to protect manufacture; but it is not needed, and is not used, in connection with distribution.

To return to the study of the curves obtained and the active capacity required, it may be noted that the demand varies from 83,000 cubic feet, or 8·3 per cent., to 116,000 cubic feet, or 11·6 per cent., of the day's output, and the active capacity also varies. The following table shows the peak demands in cubic feet per hour, and the active holder capacity required in percentages of the day's output:—

Curve.	Peak. Cubic Feet Per Hour.	Active Storage. Percentage of Output.	Curve.	Peak. Cubic Feet Per Hour.	Active Storage. Percentage of Output.
1.	87,000	20·3	8.	102,000	19·2
2.	103,000	20·3	9.	106,000	22·0
3.	83,000	19·3	10.	91,000	21·4
4.	102,000	23·7	11.	103,000	23·3
5.	113,000	29·4	12.	101,000	22·3
6.	106,000	19·9	13.	116,000	23·6
7.	91,000	17·3	14.	102,000	27·5

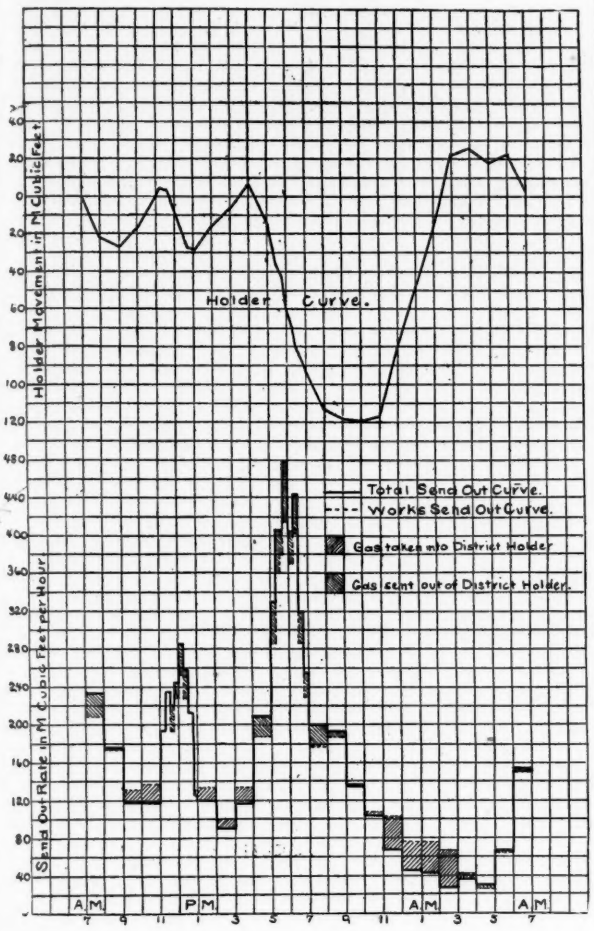
First comparing curves with about the same demand, we find that Nos. 8 and 14 have a demand of 102,000 cubic feet; but the holder capacity required by No. 8 is 19·2 per cent., and by No. 14 27·5 per cent. This indicates that whereas the output, and therefore the revenue, is the same, and the peak demand, and therefore the mains, is just the same, No. 14 requires 43 per cent. more active storage capacity than No. 8. Nos. 3, 6, and 8 have practically the same requirement in storage; but Nos. 6 and 8 have demands about 25 per cent. greater than No. 3.

These are mostly isolated curves reduced to a common basis for comparison. To deal intelligently with a given case will require many curves covering the whole year, so as to determine with certainty the maximum demand and the maximum storage in actual figures. For example, for curves Nos. 12 and 13, the actual data are as follows:

Date.	Output. Cubic Feet.	Peak Demand. Cubic Feet Per Hour.	Storage Used. Cubic Feet.
Dec. 24	4,216,000	426,000	940,000
Dec. 19	3,975,000	461,000	934,000

It will be noted that the maximum demand does not follow the output nor the active storage.

A district holder such as that advocated in the paper has been in use in Denver for two years. The following diagram may, therefore, be of interest. The solid line shows the total send-out just as it would be without the district holder; and the broken one, the send-out from the works alone. The difference between the two shows the rate at which gas was put into, or drawn from, the district holder. The holder curve shows the amount of active district holder storage required to effect this result.



The full value of a district holder cannot be judged from the curves, because this holder is attached to only one branch of the distribution system; the other three branches dealing with about two-thirds of the total gas. However, the peak demand has been depressed about 14 per cent. The amount of active capacity in the district holder to accomplish this result was 4 per cent. of the day's output, and 25 per cent. of the total active storage.

This method of using district holders does not require any additional holder capacity, but rather a division of the capacity into holders of suitable size, and so located and connected to the network of mains that the benefit of the total storage is made to apply as nearly as possible to all the distribution system. In such a system of holders, one will be needed near or at the works, and may be included in the works holder, with whatever reserve storage it seems necessary to maintain. The same storage capacity which would become active if all storage were at the works would be ample if a portion were distributed as district holders. This feature should not be lost sight of. If additional storage must be provided, either active or reserve, the possibility of distributing this additional storage about the network of mains, and so increasing its usefulness about 100 per cent., should certainly be looked into.

The conditions that particularly favour district holders are: (1) High peak demands. This means that there is room for much saving in distribution capacity. (2) The more valuable the portion of the distribution system that can be placed between the holder and the works, the greater the advantage of a district holder. This means that long and expensive mains will be given the benefit of a more uniform load curve. (3) When additional storage becomes necessary to provide for active storage needs. In this case, the storage must be provided in any event; and it is only a question of its location. The amount of active storage necessary to handle the load curve—whether large or small—has nothing to do with this condition, except in determining the needs of each gasholder location, so that storage will not be wasted by being too large, or benefit lost by being too small.

The first and second conditions make district holders possible. The third may have no weight, because though the plant will in time grow to any reasonable storage capacity, it may take so long that the interest on premature storage investment may amount to more than the value of the holder.

The late Sir William J. Crossley, Bart., whose death was recorded in the "JOURNAL" for the 17th of October, left estate which has been valued for probate at £602,030 gross, of which £578,286 is net personalty. The will does not contain any bequests to charities; but the testator has left £500 each to an ex-cashier and an ex-secretary of Crossley Bros., Limited.

SCOTTISH JUNIOR GAS ASSOCIATION.

WESTERN DISTRICT.

A Monthly Meeting of the Association was held in the Technical College, Glasgow, last Saturday evening. Mr. J. M'GHEE, the President, occupied the chair; and there was a good attendance of members.

MR. W. B. M'LUSKY ON THE SALE OF GAS.

The PRESIDENT, in introducing Mr. W. B. M'Lusky, Gas Engineer and Manager to the Perth Corporation, to give an address, said he thought the members ought to be very pleased and flattered with the way in which members of the Senior Association came forward to assist them in every possible way. He asked Mr. M'Lusky to deliver his address.

Mr. M'LUSKY said: I have pleasure in acceding to the request of your Secretary to give a short address. In considering what topic could be most conveniently compressed within the limits of a fifteen minutes' discourse, I have found the choice of suitable subjects large and full of interest. The question with me was, first, which subject is most pressing, and, secondly, which would be most interesting; and I concluded that a strictly commercial problem would be most appropriate. Therefore I propose to address you on "The Development of the Sale of Gas;" and I will limit the scope of my remarks to the supply of consumers' burners and stoves, and the keeping of these in proper working order when fitted.

Notwithstanding the great progress already made in the supply of gas, we are, in my opinion, on the threshold of a period of prosperity which will completely overshadow the greatest achievements of the past—a period which, however, will be characterized by keener competition than we have yet experienced, and which will demand increased activity, and, if possible, greater efficiency on the part of every worker, more particularly those engaged in distribution and maintenance. Makers of burners, mantles, and stoves are doing their part; and a greater appreciation of the value of gas by the public is daily becoming more evident. It now remains for the owners of gas undertakings to get their customers not only to use gas, but to consume it to the best advantage to themselves. The way should be made easy for the gas user in this respect by providing him with proper facilities. Where the gas undertaking is in the hands of a company, no obstacle is placed in the way; and it is difficult to understand the prejudice that exists in some quarters against local authorities dealing directly with their consumers in the matter of providing them with modern facilities for the use of gas. In all circumstances, it should be the policy of the management to work hand in hand with the private trader. In small towns—indeed, in any town—it is an advantage to the trader, the gas undertaking, and the consumer to hold a stock of fittings and burners at the show-rooms, where the trader can send his prospective customers to make a selection under skilled direction—the articles selected being invoiced to the trader at wholesale prices, fitted by him, and inspected by the officers of the gas undertaking when done. Where the gas undertaking does not find it expedient to deal directly with the consumer, such an arrangement has been found to work satisfactorily in the interests of all concerned. Wherever the gas undertaking enters into competition with the trader in the carrying out of such work, there is always the risk of the business suffering as the victim of conflicting interests.

When the work has been completed, the question of maintenance arises; and this work, in my opinion, must be carried out by the undertaking. If it is left to the trader, nothing is done until some complaint is made; and the cost of employing a trader to investigate the cause of complaint and make the necessary adjustment and repair is prejudicial to the interests of the undertaking. Regular skilled inspection and maintenance of consumers' fittings and burners should be provided free of charge by the gas undertaking; the consumer paying for the replacement of materials such as mantles and globes. We must maintain our position as the premier providers of light; and to do this we must aim at a high standard of efficiency. There is no part of our work in more need of special effort; and there is nothing we could do which would contribute so much to the development of our industry.

The neglected appearance of incandescent burners and mantles which one observes in so many places, is a menace to the prosperity of our business. Many consumers would appear to buy cheap burners and accessories from general dealers, and fix them on rickety and crazy fittings which are not at all suited for incandescent lighting. Such fittings are usually badly put up and unsatisfactory in use; and premises lighted in this manner form an easy prey to the electric undertaking's inspector. The consumer who can afford to pay for electric lighting can well afford to invest in new gas fittings and burners, pay for his gas lighting at a rate which will cover free maintenance of fittings, stoves rent free and fixed free, and have sufficient money left to buy gas for heating or for other purposes. The system outlined, of exhibiting approved gas fittings at the show-room of the gas undertaking, and having these fitted by approved traders under the supervision of the gas undertaking, is a most effectual means of protecting the consumer against "jerry" work.

In the stoves business also the private trader is willing to work hand in hand with the gas undertaking. Even when stoves are

fixed free and lent at a moderate rental or free of rent by the gas undertaking, there are many consumers who would prefer—many do prefer—to have the work done by their own tradesmen, rather than enter into a contract with the gas undertaking to pay so much rent or consume so much gas per annum; and it is a wise policy to take advantage of the trader's business connection, supply him with the apparatus at net cost, and make a contribution towards the expense of fitting. For the bulk of gas consumers, however, it is necessary for the gas undertaking to provide the capital; and when this is done, the only question is whether the consumer should be asked to return the outlay in hire-purchase instalments, or whether it is more advantageous to hire the article at a small annual rental, or lend it free of rent, depending upon a return from the gas consumer. It is well known that consumers in many cases object to pay a rental for the use of the stove and at the same time pay the ordinary rate for the extra gas which they consume by this means; and where it can be explained to the consumer that the remission of an annual rental amounting to (say) 7s. per annum is equivalent to a rebate of 1s. per 1000 cubic feet on the 7000 cubic feet of gas which he uses in the stove in the course of a year, he makes a more liberal use of the article. In this way the gas undertaking, which, owing to heavy fixed charges or other causes, must charge 2s. 9d. per 1000 cubic feet for gas, is, by the remission of the stove-rent, giving the consumer facilities equal to gas at 1s. 9d. per 1000 cubic feet, *plus* stove-rent. This may perhaps explain why it is that the amount of stove business done in districts labouring under the disability of a high selling price is equal to, and in many cases more than, that done in other districts where the selling price of gas is low and the facilities provided for the use of stoves are not so attractive. If it is the aim of the undertaking to make a profit out of the apparatus itself, it is a mistake to imagine that this can be done by means of rental. It seems to me that the choice in this respect lies between sale outright and loan free of rent. The rent, however, does not deter the consumer from entering into a contract to use the apparatus for one year; but it very often has the effect of causing him to return the apparatus after a year's trial. In such a case, the rent collected will not pay for the cost of fitting-up; and when the article is removed, the cost of removal and overhaul, *plus* depreciation, becomes a heavy charge on a piece of apparatus which is not producing any revenue.

Quite a number of gas undertakings make a distinction between cooking-stoves and other apparatus, whether the apparatus is loaned free or let out at a rental. In some cases cookers only are loaned and in others cookers and fires only; all other apparatus being dealt with on a different basis. These artificial distinctions between one piece of apparatus and another have a very disturbing effect on the public mind. The prospective consumer is bound to assume that the distinction is made in the interests of the undertaking alone; and this does not conduce to the best business relationship. All descriptions of cooking and heating apparatus, including gas-fires and water-heaters, have during the past fourteen or fifteen years been loaned at a moderate rental to the gas consumers of Perth; and experience has all along proved the wisdom of this policy. Slot-meter consumers in Perth have for many years enjoyed the benefit of gas-fires as well as cooking-stoves free of rent; and the rental formerly charged to ordinary meter consumers has been abolished as from the beginning of the current financial year.

The great improvement in gas-fires during the past few years is bringing within the reach of the smallest consumer the advantages of this form of heating; and, rightly handled, this business is bound to yield a rich harvest to the gas undertaking, for the small consumers are many. Where the number of stoves in use, in proportion to the total number of consumers, is large, inspectors are required to look after the property of the undertaking, and see that it is used, and used to the best advantage. Where the number of stoves is not large, inspectors are necessary if the number of stoves is to be increased. It is wonderful how far 1d. per 1000 cubic feet will go in the payment of maintenance inspectors' wages; and it is still more wonderful how the value of 1d. per 1000 cubic feet will increase as the result of the increased business which will accrue from efficient inspection.

Eight years ago, the Perth Town Council adopted the policy of inspection on a moderate scale; and, so far as the system has gone, it has been greatly appreciated. The consumer whom we can assist to effect a saving in his account for lighting is likely to become a customer for cooking, heating, or both, and to influence his friends and neighbours to adopt gas for lighting and other purposes. During the past ten years, with a very trifling increase in population, the number of gas consumers in Perth has increased from 8376 to 11,037; and while the average consumption per consumer for lighting alone has fallen from 17,361 cubic feet in 1900-01 to 13,626 cubic feet in 1910-11, the number of stoves in use has increased from 971 to 12,119, which, notwithstanding the economies effected in lighting, has resulted in an increase of 36 per cent. in the sale of gas.

The representative of the gas undertaking or the inspector can also be instrumental in pushing the use of gas for industrial purposes; and, in these days of competition with efficient oil-engine and suction gas plants, it is well to have a scale of special rates for such purposes, anticipating as far as possible the needs of prospective users of gas. Since the industrial, commercial, and power purposes scale was introduced in Perth eight years ago, gas has been more largely used for industrial as well as for commercial and power purposes. Special rates for such purposes often have the effect of influencing manufacturers when the choice of a site is under consideration; and the gas undertaking that meets this demand for gas may be the means of bringing new industries to the town—thereby conferring a benefit not only on the consumers of gas but also on the whole community.

We are liable to forget that we are not alone in the work of helping the gas user. Tools of ever-increasing utility are being constantly put into our hands by makers of stoves, burners, and mantles; and it is our duty to see that these helpers get all the encouragement they deserve. What an enormous difficulty, for example, would be removed out of the way of gas apparatus makers if we could effect a standardization of quality and pressure. Not for their sakes alone do I here suggest such a standardization; the gain to all concerned would be well worth striving for. The British Commercial Gas Association might help towards the realization of this end. As the Association will consist not only of gas officials but of directors of gas companies, members of municipal gas committees, and gas apparatus makers, the force of the united opinion of such a combination would be irresistible, and would break down the prejudice that exists in many quarters against the adoption of a common standard. Meanwhile, it is necessary to make the most of existing conditions, by the exercise of proper control from the station governor to the consumer's burner, by proper gradations of initial pressure from hour to hour, to meet the requirements of every district, as ascertained by 24-hour records of pressure taken in the various districts from time to time, and by the fixing of service governors close to consumers' meters to control the variations of pressure which occur there in accordance with the consumers' demands, which variations, of course, occur independently of the pressure in the main. Where required, these governors should be fitted free at a small rental.

There is a vast and rich field before us; and I am convinced that the methods I have indicated would prove to be very fruitful seed. To the large faith and the wise sowing of our fathers we owe the high position we occupy to-day. Have we faith enough in the still greater possibilities of our industry to take up the task that has been handed on to us, and, quickened by the vision of service to the community that may, if we are willing, be ours, sow yet more wisely?

Discussion.

The PRESIDENT, in inviting discussion, said Mr. M'Lusky had presented many matters which needed thrashing out; and there was ample room for discussion. Some of the points appealed to them in Glasgow as they had done to Mr. M'Lusky in Perth. One of these was the question of constant pressure which was put before him in a practical way by a consumer who recently asked him whether it was not the duty of the Gas Department to supply him with gas at a constant pressure. He did not consider it was part of his business to provide a governor or pay rental for one, but theirs to give him an equal pressure.

Mr. A. WILSON (Glasgow) expressed the indebtedness of the Association to Mr. M'Lusky for giving them so able an address. The way in which he had treated his subject showed that they were thoroughly up-to-date in Perth; but they were slightly behindhand in some of the things about which he had been telling them. He spoke as to the difference between the dealings with consumers where there were companies and corporations. In the main, Mr. M'Lusky was right. A gas company had a free hand; whereas in the case of corporations there were so many outside interests, who were afraid that the corporation was antagonistic, that there was not the same freedom. He thought this was a great pity for everybody. Mr. M'Lusky told them he was giving out free stoves. He (Mr. Wilson) hoped they would very soon be doing the same in Glasgow. The Committee dealing with the matter had been favourably impressed with the information they had received from various towns where stoves were supplied free; and this went to show it was for the benefit alike of the gas department and the consumers. He thought Mr. M'Lusky was right with regard to burners. The great trouble of the gas department in pushing its business for lighting was the upkeep of burners. On his way to the meeting, he noticed the difference between the shops. Where the burners were kept in good order, it was a credit to the gas lighting, and was bound to have some effect in inducing people to use gas. Other shops, however, were anything but a credit, either to the owners or to gas lighting; and where these shops happened to be alongside others in which electric light was in use, there was no doubt the shop so lighted looked very much better than the gas-lighted one. This could only be got over by taking up the position which Mr. M'Lusky advocated, and seeing to the maintenance of the burners. In Glasgow they had not done much in this way. They tried it, but they had had so much opposition that it had been dropped almost entirely. He thought they would have to consider the subject again, if gas lighting was to take the place it ought to do.

Mr. J. M'LEOD (Greenock) characterized the address as very inspiring. He said the trouble the gas manager had now-a-days was on the distribution side; and the difficulties were many. One of the principal of them was the question of getting a good class of fitter—a smart, intelligent gas-fitter who was capable of going among the consumers, advising them intelligently, speaking civilly, and being able to mollify them when they were full of complaints, and speak up generally for gas. The difficulty there was that they were not offering a sufficient wage to induce a higher class of

men to take up gas-fitting. Until they gave a better wage, they need not expect to get a higher type of men for this particular purpose. They came in contact with the consumers much more than the manager did. Mr. M'Lusky had mentioned the arbitrary distinction between certain classes of cooking appliances. He (Mr. M'Leod) introduced free cookers in Greenock with great success a year-and-a-half ago; but he had not yet touched other appliances. His reason for not introducing fires and hot water appliances was that they had not reached fixity of pattern. The cookers of to-day differed in very few respects from those of some years ago. But the fire was as different as night from day; and hot-water appliances were the same. When they had reached fixity of pattern, he would have no hesitation in introducing them. The free cookers had been a great success in Greenock, and had increased his gas output from 7 to 16½ million cubic feet; or, put in another way, by an expenditure of £250 he had gained an increased income of £2000. Managers must also try their best to give a uniform pressure; but the difficulties seemed to him to be great. Was there a governor on the market at present which was low in cost and absolutely reliable in action, and which would give a minimum pressure? If this question could be answered in the affirmative, there was no reason why they should not put in a governor as well.

Mr. A. Wright (Strathmiglo) said he was in Greenock when the gas-cookers were started there. Gas-fitters put them up, and they were very much spoken against, because the men did not fit them properly. When the consumers complained to the gas-fitters, they were told that they knew nothing about the matter, and that the fitters knew their business as well as the consumers. They could not get efficient fitters unless they paid them an adequate wage.

Mr. F. L. M'Laren (Dumbarton) said that, so far as his experience went, many gas managers were quite satisfied, when they received complaints, to put on pressure, without caring what became of it. It was a great pity that sellers of gas did not satisfy themselves more that the public were getting the correct form of lighting they wanted. Had gas manufacturers turned away when incandescent mantles were introduced, and not concerned themselves with them, where would gaslight have been to-day? It would be completely eclipsed by the electric light. They must move with the times; and therefore he thought there was great necessity for the gas manufacturer getting on a better working basis with the local plumbers and gas-fitters.

Mr. J. Frazer (Glasgow), speaking of the inability of outside fitters to deal with gas-fittings, said he questioned if 5 per cent. of the men employed were really efficient fitters for incandescent gas lighting. They did not know or take the trouble to learn what was the size of pipe necessary for a fire or a stove, because it did not come within their province. It would be wise if the Corporation took the plumber in hand in this business; but, as Mr. Wilson had said, they were tied up. There was no reason why this should be. He thought the time had come when the gas company or the corporation should take the gas from the retort right to the consumer. He did not know why they should supply the cooker free and not the fire or the radiator. It was not the price of the fire or the radiator that prevented this being done, but the fitting in of the pipe. The corporation should have the power to reach the public and put in the proper size of meter for the fire or radiator. The question of house governors was coming to the front; and he did not see why a governor, mercurial or otherwise, should not be part of the meter.

The President asked Mr. M'Lusky if he would advocate supplying materials at net or retail price, so as to obviate trouble with outside suppliers. He considered there was a good deal to be said in favour of the fact that corporation show-rooms would sell the best class of fittings. As to the efficiency of gas-fitters, it was not a matter of good wages, it was getting a man to do an honest day's work. The men could do the work, but they seemed to think that when they got into corporation employment their business was to get the day in as easily as possible. The great want of the present time was honest service.

Mr. M'Lusky, replying to the remarks made, stated that in selling mantles he would certainly charge the retail trade price. He thought they must recognize the trade in all their transactions —meet them on a business footing, and discuss the problem with them. Their difficulty was that the outside trade did work which was not creditable to tradesmen. All corporations who were under the Burghs Gas Supply (Scotland) Act had the power of visiting and inspecting their gas appliances. It was only undertakings which had Acts of Parliament of their own that had less power. In 1906, they in Perth applied to Parliament for further powers; and they came away poorer than they went. They benefited to the extent that when any alteration was made on a property they could step in and clear out the whole of the pipes if they thought it necessary. He advocated the appointment of an inspector to examine burners and other appliances, because where this work was left to the gas-fitter they had no inspection till the consumer complained. The result was that the fitter went to see what was wrong, came back for a mantle, and returned to put it on. The gas department should take the burner over, and maintain it at the consumer's expense.

ELECTRICITY IN A GAS-WORKS.

Mr. J. Wilson (Falkirk) read a paper upon this subject, in the course of which he said it was his intention to follow the coal as it came into the gas-works until it reached the retorts, and thence to follow its constituent coke till it arrived at the coke heap; and in doing so to consider especially the form of motive power which had been adopted in Falkirk for driving such plant as they might find in use on the way.

In the first place, they saw the works "pug" engine placing the coal-waggons in position over the hydraulic tipping rams. There were two rams—one on each side of the coal-crusher. The hopper measured 10 feet by 8 feet by 8 feet deep, and contained a sliding-door fitted in the bottom, so that the rate at which the coal may be fed into the crusher is under the control of the attendant. The crusher can deal with 35 tons of coal an hour, and is provided with a double set of rollers, so arranged that, if desired for storage, the coal crushed by the upper rollers may be bye-passed direct into the elevator boot without further crushing. There is an extra door in the bottom of the hopper, so that nuts that do not require to be broken can be bye-passed direct to the elevator. A chain-driven bucket elevator, 70 ft. centres by 1 ft. 6 in. wide buckets, delivers the coal from the crusher to the conveyor. The two pumps for supplying the necessary hydraulic power to the tipping rams are underground, alongside the crusher, and are driven from eccentrics fitted on the main driving shaft of the crusher. They had recently fitted a clutch gear to this crusher, so that when dealing with nuts that do not require further breaking up, the crusher might lie idle while the pumps and elevator were in operation. This should effect some little saving in current consumption.

The foregoing pumps, crusher, and elevator were driven from a compensated shunt-wound motor of the enclosed type, developing 35 H.P. at 980 revolutions per minute for 62·5 amperes at 460 volts. The speed was reduced in the ratio of 5 to 1 by means of a countershaft bracketed on to the motor body. The pinion of the armature spindle was of raw hide and meshed with a cast-iron machine-cut spur-wheel on the countershaft. From this countershaft to the main driving shaft the drive was by Balata belting, through a further reduction of 2 to 1. The motor itself was fixed underground; but the starting switch was placed on the wall at a convenient height above the ground level. It had been found necessary to have the cables leading to the cellar lead covered, owing to dampness. The form of starter was that of a rheostat, with a pivoted contact arm swinging through an arc of about 90°, and cutting out resistance in moving from left to right. It had a sufficient number of contacts to ensure easy acceleration of speed by limiting the rush of current with easy decrease. It was made to switch off automatically by an arrangement called a no-load and overload release.

The coal, on leaving the elevator, was dropped into a scraper or push-plate conveyor (No. 1), 105 ft. 5 in. centres by 2 ft. 6 in. in width, travelling over the coal-store, and depositing the coal into the cross conveyor (No. 2) of similar type. This cross conveyor is 2 ft. 6 in. wide by 27 ft. 5 in. centres, and carried the coal from conveyor No. 1 to conveyor No. 3. The first two were driven from a 10 H.P. shunt-wound motor running at 900 revolutions per minute for 18 amperes at 460 volts. This was also of the enclosed type, and had a 5 to 1 reducing gear bracketed on to the frame, with a further reduction of 2 to 1 through the belt, and was provided with starter, fuses, and a double-pole switch to suit. In addition to the outside coal-crusher, there was one inside for dealing with the coal in the store. This was provided with one set of rollers only, and was capable of crushing 35 tons of coal an hour. A bucket elevator, 61 feet centres by 1 ft. 6 in. buckets, delivered the coal from this crusher to the cross conveyor; so that, when wanted, the coal from the store might be mixed with fresh coal coming in.

The motor for driving this crusher and elevator was exactly similar to the outside crusher motor, and was interchangeable with it; so that in the event of anything going wrong with the outside motor, they could unship it and put in the other motor while repairs were being executed. The main or outside breaker and elevator motor had more work to do—namely, hydraulic tipping and breaking rough coal; so that a motor of less horse power would have sufficed for the inside breaker. But the advantages of having the two motors the same was obvious.

Extending along the whole length of the retort-house, on the machine side, were twelve storage hoppers, measuring each 11 ft. 6 in. by 8 ft. by 7 ft. deep and having a capacity of 10 tons each. There was thus storage for 120 tons of coal above the machines. A conveyor (No. 3), 140 ft. centres by 2 ft. 6 in. wide, takes the coal from the cross conveyor and feeds it into any or all of the storage hoppers as desired. The motor for driving this conveyor was similar to that driving conveyors Nos. 1 and 2, but is 15 H.P., running at 480 revolutions per minute for 27·3 amperes at 460 volts. This conveyor was driven by a 6 H.P. motor; but as it had been giving some trouble, the 15 H.P. motor, which had become spare owing to the rearrangement in the coke-handling plant, was fixed up in its stead. It had given no trouble since; while the current consumption compared favourably with that of the 6 H.P. motor. This concluded the coal-handling plant; and a glance at Table No. 1 would give an idea of the costs, which had been worked out to pence per ton of coal carbonized.

Stoking Machinery.

They now came to the stoking machines. These consisted of one charging machine and one pushing machine. The charger was that of the rotary blade type (Toogood's patent), and was capable of charging one retort in 30 seconds with an 8-cwt. charge. It had two motors—a variable speed motor to drive the projector,

TABLE No. 1.—*Coal-Handling Plant.*

	£	s.	d.	Cost per Ton of Coal Carbonized. 1909-10. d.		1910-11. d.	
Cost of plant, exclusive of electricity gear	3,126	14	4	—	..	—	
Sinking fund and interest at 6 per cent.	187	12	0	2·10	..	2·08	
Maintenance wages			2·36	0·07	..	0·06	2·22
Maintenance material				0·19	..	0·08	
Cost of electricity gear	502	0	0	—	..	—	
Sinking fund and interest at 6 per cent.	30	2	5	0·34	..	0·34	
Operating wages				2·04	..	1·47	
Maintenance wages				0·23	..	0·10	
Maintenance material				0·22	..	0 27	
Current used, at 1¼d. per unit				1·01	..	1·03	
				6·20	..	5·43	

and one which might be used either for travelling the machine along the stage floor or for raising and lowering the projector to the required height.

Table No. 2 showed the costs for stoking by the machines.

TABLE No. 2.—*Showing Cost of Stoking Machinery.*

	£	s.	d.	Cost per Ton of Coal Carbonized. 1909-10. d.		1910-11. d.	
Cost of machines exclusive of electricity gear	1000	0	0	—	..	—	
Sinking fund and interest at 6 per cent.	60	0	0	0 67	..	0 66	
Maintenance wages			1·38	0·61	..	0·61	1·99
Maintenance material				0·70	..	0·72	
Cost of electricity gear	158	5	0				
Sinking fund and interest at 6 per cent.	9	9	1	0·11	..	0·10	
Wages of operators				2·04	..	2·02	
Maintenance wages				0·30	..	0·10	
Maintenance material				0 18	..	0·22	
Current used, at 1¼d. per unit				0·43	..	0·23	
				5·04	..	4·66	

METHOD OF DEALING WITH COKE.

The coke, on leaving the retorts, fell into boxes underneath the stage floor, and was immediately quenched. A moveable bottom fitted on to these coke-boxes allowed of the coke being dropped into small side-tipping waggons running on rails. After the waggons were filled, they were pushed out by hand to the coke-hoist. There were three landing stages on the hoist. The first allowed the coke to be shot direct into waggons. The second was the storage quantity, which ran out for about 80 feet, and from which the coke was binged. The third was the topmost, and from it the coke was tipped into the receiving hopper of the riddle. The respective heights were as follows: First, 14 feet; second, 26 feet; third, 36 feet.

The cage was counterbalanced by a back weight, and was operated from a winch driven by a motor through worm-gearing running in oil; the end thrust on the worm being taken up by ball bearings. The motor was 10 H.P., running at 900 revolutions per minute for 21·2 amperes at 460 volts, and was compensated series wound. The hoist was designed to lift 1 ton at a speed of 80 feet a minute, and took 25 seconds to reach the top landing with a full bogie of coke. The time taken to push the bogie out to the riddle receiving hopper, empty it, and return to the cage was 25 seconds. The descent to the ground level occupied another 25 seconds; so that the time required for the whole operation was 1¼ minutes. In time of (say) a shipment they could load 100 tons of coke a day by this means. The riddle used was of the revolving double screened type; and from it the coke fell into one of three hoppers, according to its size—namely, large, nuts, and breeze. These hoppers could hold respectively 25 tons of coke, 10 tons of nuts, and 25 tons of breeze, and had a sliding door fitted in the bottom for discharging their contents into carts or waggons. The riddle was driven from a 4 H.P. compensated shunt-wound motor running at 1000 revolutions per minute for 7·9 amperes at 460 volts. The motor was fixed on the second stage platform, and was connected to the main spindle of the riddle through worm gearing running in oil similar to that of the hoists. Table No. 3 showed the costs worked out to pence per ton of coal carbonized.

The labour charges from coal-waggon to coke heap or hopper amounted to 13·97d. per ton of coal carbonized in 1909-10 and 13·55d. in 1910-11. To ensure sweet running, with freedom from breakdown, on e of the essentials—indeed, one might say the essen tial—was cleanliness. Dust, especially when mixed with oil, and damp were the greatest enemies of electrical plant. The dust about a gas-works was largely composed of coal and coke, which, being carbon, formed a good conductor of electricity.

All motors and starters should be examined at least once a day. While taking precautions that the motors had always a sufficient quantity of oil, over-oiling was to be avoided, as surplus oil would, through time, soak through the motor connections and cause earthing or a short-circuit. In regard to the oiling device used in motors, it was wise to look at the rings regularly, to make sure that they revolved and carried round the oil. Sometimes, owing to a soft part in the metal, or perhaps through becoming damaged, these rings developed a flat on the inside diameter, and tended to remain stationary on the shaft, resulting in a seized bearing. The bearing bushes should be examined for wear frequently, because the air gap on motors was now cut so fine that too much wear in the brasses would allow the armature to come in contact with the lower field magnets and cause damage.

TABLE No. 3—*Cost of Coke-Handling Plant.*

		Cost per Ton of Coal Carbonized. 1909-10. d.	1910-11. d.
Hoist complete	£317 0 0		
Hoppers and structural work	250 0 0		
Riddle	39 0 0		
Riddle motor, &c.	58 0 0		
	£664 0 0		
Interest and sinking fund at 6 per cent.	39 16 10	0·45	0·44
Operating wages		1·02	1·01
Maintenance (exclusive of electricity gear) material		1·35	0·74
Maintenance (exclusive of electricity gear) wages		0·23	0·31
Maintenance, electricity gear, material		0·20	0·24
Maintenance, electricity gear, wages		0·20	0·10
Current used		0·33	0·26
From retort to coke-hopper		3·78	3·09
Cost per ton of coke produced		6·60	5·32

In choosing a motor, avoid those in which space was reduced to a minimum. A cramped motor rarely gave satisfaction; being very difficult to keep clean, besides proving very un-get-at-able for repair. There was always a considerable amount of end-play in the armature spindle of the motor, to allow the armature to take up its own position with respect to the field magnets. They did not generate current at the gas-works; but were supplied from the Electricity Department at the price of 1¼d. per unit. He was convinced, however, that if they were to employ a gas-engine, running on town gas, to drive a small dynamo, they would be able to make their current at a much cheaper figure.

TABLE No. 4.—*Electric Consumption and Cost per Ton.*

	1909-10		1910-11.
Tons of coal handled	21,380	..	21,632
Outside Breaker and Elevator.			
Current used in units	8,548	..	9,132
Consumption per ton of coal	0·4	..	0·42
Cost per ton of coal at 1¼d. per unit	0·5d.	..	0·54d.
Conveyors.			
Current used in units	8,178	..	8,388
Consumption per ton of coal	0·38	..	0 38
Cost per ton of coal at 1¼d. per unit	0·47d.	..	0·48d.
Stoking Machinery.			
Current used in units	7,364	..	3,939
Consumption per ton of coal	0·34	..	0·18
Cost per ton of coal at 1¼d. per unit	0·43d.	..	0·23d.
Inside Breaker.			
Coal handled in tons	1,058	..	416
Consumption per ton of coal	0·55	..	0·78
Cost per ton of coal at 1¼d. per unit	0·69d.	..	0·98d.
Current used	584	..	326
Hoist and Riddle.			
Current used	5,696	..	4,554
Coke handled in tons	12,231	..	12,572
Consumption per ton of coke in units	0·46	..	0·36
Cost per ton of coke at 1¼d. per unit	0·58d.	..	0·45d.
Coke sold in tons	11,531	..	14,793

The PRESIDENT said the paper was a very interesting one, and one on which the author was to be highly complimented.

Mr. W. B. M'LUSKY (Perth) said as he was the greatest stranger, and had received a very flattering reception by the Association, it was his duty to offer his congratulations and hearty thanks to the young member who had read the paper. He said in all sincerity that, from beginning to end, it was greatly to be appreciated, even by many gas managers. The speaker closely reviewed the figures given by Mr. Wilson, and asserted that electricity could be generated very much more cheaply in a gas-works than it could be purchased for from an electricity department. Seeing that vertical retorts were likely to come more into use, he thought Mr. Wilson ought to have allowed a higher figure for sinking fund than he had done.

Mr. W. GRAFTON (Glasgow) referred to the cost of coke and coal handling. He said that, according to the statement in the paper, the cost showed an increase of 0·37 per cent., which apparently was not a very serious matter. The author entirely forgot to present the make per ton instead of the tonnage only for the two years. He handled 390 tons of coal less in the year 1911 than in 1910; whereas against this there were 341 tons more coke handled, or a difference of 49 tons against the 1911 account. The chief reduction in the account seemed to be in the wages per ton of coal carbonized.

Mr. W. BLAIR (Helensburgh) said he was not able to make a comparison between vertical retort carbonizing and electricity, not having had a full year's experience; but he believed that at Helensburgh they could handle coal and coke material at even the best in Falkirk.

Mr. J. FRAZER agreed that it would be beneficial to the inhabitants to have electricity used in gas-works generated on the works. He did not, however, agree with Mr. M'Lusky regarding the price of gas; it must be the cost of the gas less distribution. They could not make gas without fixing all the charges on it.

Mr. J. WEBSTER (Provan) spoke briefly on the paper.

HIGH-PRESSURE GAS APPLICATION.

By E. W. Smith, M.Sc.

[A Lecture delivered at the Manchester University, Dec. 2.*]

Before going on to the subject proper of my lecture, I wish to say just one word in connection with problems one meets with in the distribution of gas. In Glasgow, at the annual meeting of the Institution of Gas Engineers, in June last, I stated, in a paper I had the honour to read, what I considered to be the requirements of a service governor, and made the statement that so far no governor within my experience had proved satisfactory. I take this, the earliest opportunity I have, of saying that there are now on the market governors which more nearly approach the standard I then set up than I thought they would be likely to do. The following are the results obtained from one of these governors.

Tests on Half-Inch High-Pressure Gas-Governor.

This governor was of the diaphragm type, having a tension loading spring acting on the upper surface of the diaphragm. The following tests were made:

(1) The inlet pressure remained constant at about 23·3 inches of mercury, while the outlet pressure was adjusted to (*a*) 60 inches of water, and (*b*) 80 inches of water. In each case the consumptions were varied from about 10 to 500 cubic feet per hour; and the corresponding variations in the outlet pressure were carefully observed. In these tests, the governor was adjusted to give the required outlet pressure with a mean consumption of about 200 cubic feet per hour; the consumption being then varied by increments to about 500 cubic feet per hour, and afterwards decreased from about 200 to 10 cubic feet per hour. The governor was then tested for gas leakages, and its mechanical construction carefully examined.

[Note: All consumptions were provided by means of jets previously standardized by means of a test meter.]

Summary of Results of Tests Nos. 1 (*a*) and 1 (*b*).

From Test 1 (*a*), it will be noted that, with an outlet pressure of 60 inches of water and with a consumption varying from 518 to 25 cubic feet per hour, the maximum variations in the outlet pressure were −2·7 and 4·5 per cent. respectively; while with an outlet pressure of 80 inches and with a consumption varying from 596 to 31 cubic feet per hour, the maximum variations in the outlet pressure amounted to −3·3 and 5 per cent. respectively—the governor working very satisfactorily between these limits.

(2) The governor was then tested for gas leakage, and its mechanical construction carefully examined. The leakage through the diaphragm was found to be exceedingly small—the governor being perfectly satisfactory in this respect. The main case joint was also found to be perfectly gas-tight with an outlet pressure of 80 inches of water. The screwed cap was found to leak slightly; and owing to the leakage through the adjusting screw, subjecting this cap to full inlet pressure, it would be advisable to introduce some form of joint-ring (*e.g.*, a lead washer), to ensure perfect gas-tightness at this joint.

With reference to the mechanical construction of the governor, the following points were observed: (1) Diaphragm composed of best quality pliable leather, specially prepared and lined with goldbeaters skin. (2) Valves massively constructed, and fitted with best quality leathers. Ample valve area provided, and thus wire-drawing reduced to a minimum. (3) Tension springs should prove more satisfactory in their working than compression springs, owing to the tendency to distortion being minimized. (4) A good bearing surface is provided for the diaphragm joint by means of a spigot set off from the main case in the main casting—this enabling a considerable pressure to be brought to bear between the two halves of the case, and thereby producing a gas-tight joint. [It will be noted that the joint surface is uniform, and is not cut away at the points where the holding-down bolts are screwed in, owing to the above spigot arrangement.]

Results of Governor Tests.

1 (*a*).—*With Outlet Pressure Adjusted to* 60 *Inches Water, Inlet Pressure Constant at* 23·3 *Inches M., and Consumptions Varied from* 10 *to* 500 *Cubic Feet per Hour.*

Inlet Pressure.	Outlet Pressure.	Consumption Corrected to 20/10 Inches	Variation in Outlet Pressure.
Inches Mercury.	Inches Water.	Cub. Ft. Per Hour.	Per Cent.
23·3	Adjusted to 60 ins.	198	..
,,	58·8	248	− 1·8
,,	,,	270	− 1·8
,,	,,	320	− 1·8
,,	,,	383	− 1·8
,,	,,	405	− 1·8
,,	,,	455	− 1 8
,,	58·3	518	− 2·7
,,	59·4	455	− 0·9
,,	60·25	383	+ 0·4
,,	61·3	320	2·2
,,	61·6	270	2·7
,,	,,	248	2·7
,,	62·2	198	3·6
,,	60·5	135	0·9
,,	61·6	113	2·7
,,	,,	63	2·7
,,	,,	50	2·7
,,	,,	36	2·7
,,	62·7	25	4·5
,,	68·0	12	13·3
,,	,,	8·5	13·3
,,	66·9	12	11·6
,,	61·1	25	1·8
,,	,,	36	1·8
,,	60 5	50	0·9
,,	,,	63	0·9
,,	60·0	113	..
,,	,,	135	..
,,	,,	198	..

1 (*b*).—*Outlet Pressure Adjusted to* 80 *Inches of Water. Inlet Constant at* 23·3 *Inches M.*

23·3	Adjusted to 80 ins.	226	..
,,	79·4	289	− 0·7
,,	,,	307	− 0·7
,,	79·0	370	− 1·3
23·2	77·8	442	− 2·7
,,	79·0	461	− 1·3
,,	77·8	524	− 2·7
,,	77·4	596	− 3·3
,,	79·0	524	− 1·3
,,	81·0	461	− 1·3
,,	79·0	442	− 1·3
,,	80·0	370	..
,,	,,	307	..
,,	,,	289	..
,,	81·6	226	2·0
23·35	81·4	154	1·7
,,	,,	135	1·7
23·5	,,	72	1·7
,,	,,	62	1·7
,,	81·6	46	2·0
,,	84·0	31	5·0
,,	86·2	15·4	7·7
,,	86·4	9·8	8·0
,,	84·8	15·4	6·0
,,	81·6	31	2·0
,,	,,	46	2·0
,,	,,	62	2·0
,,	81·0	72	1·3
,,	,,	135	1·3
,,	,,	154	1·3
,,	,,	226	1·3

Results of Test No. 2.

A single valve is used for governing, this being of ample size to prevent reductions of pressure due to wire-drawing. To the above valve is fixed, by means of a tail rod, an emergency valve, which only comes into action when the outlet pressure is suddenly reduced to atmosphere, as might take place in the event of the diaphragm becoming pierced or in the event of the outlet being suddenly open to the atmosphere, as would happen in case of an outlet pipe breakage.

Either of the above effects causes the gas to be promptly shut off automatically, owing to the diaphragm being relieved of all pressure while the spring is under tension, the spring causing the valve to shut.

[Note: In the case of a new governor being fitted, it is found that the building-up effect on a closed outlet is sufficient to cause the emergency valve, which is normally closed, to open; this being due to slight leakage through the valve.]

To facilitate the taking down of the governor for replacement of any particular part, the design might be modified by making the head containing the adjusting screw separately detachable, and affixing it to the governor body by means of a flange. Considerable difficulty was experienced in fitting up the spring controlling gear, on account of the head being cast in one piece with the body.

Governing Both Quantity and Pressure.

Another point which is perhaps worthy of mention is that, so far as one can see, there is no recognized system of governing the rate of compression in the distributing system. Each locality will settle this point to satisfy its own requirements.

Where high-pressure gas is being used in large quantities, and has to be conveyed over long distances in many directions by means of arteries branching out from a central trunk main, the problem presents a number of difficulties. Without going into the question as to what these difficulties are (it would take up a great deal too much of my very limited time), it will perhaps be sufficient for me to suggest that, whereas in many installations the aim is to keep a constant pressure in the mains at the compressor house (which will be well above any pressure that will be required in the services), it may be necessary in such installations to make arrangements for the compressors to be governed not only by the main pressure but by the velocity of the gas passing through the trunk mains. In other words, gas will have to be governed according to quantity and pressure just as in the distribution of electricity, where amperes and volts are watched in the dynamo house. I hope to deal with this matter later.

High-Pressure Gas in Industry.

High-pressure gas in its application to industrial heating processes is a comparatively new subject; and hopes have run high that its use would bring about a revolution in gaseous heating.

* A previous lecture of the series appeared in the "Journal" for Oct. 10, p. 105.

Perhaps the best that can be said for high-pressure gas, as such, in industrial heating processes is that all the effects that are obtained by means of the best type of air-blast burner, correctly adjusted, may be obtained more easily by means of high-pressure gas; and the latter will prove more reliable in its working. There are possibilities of a great advance in gaseous heating generally; but an improvement in a high-pressure furnace will almost invariably mean a corresponding improvement in air-blast and natural-draught furnaces, and *vice versâ*.

The forty-first annual report of the Deputy Master and Comptroller of the Mint proves interesting reading to all who are interested in the use of gas. For some time past, extensive experiments have been carried on with a view to displacing coke by means of gas, oil, and electricity. Gas with air-blast has proved its superiority over both oil and electricity, and, fuel for fuel, is over 25 per cent. cheaper than coke as used at the Mint. The burner found to give the best results was one made by Mr. S. N. Brayshaw, of Manchester.* I have found that with 2 to 3 inches gas pressure and 1 lb. to 3 lbs. air pressure this burner will give results which are comparable with, but by no means superior to, the results obtained by means of high-pressure gas. A burner, whether for high-pressure gas or air-blast, is only satisfactory in so far as it brings about satisfactory mixing of air and gas before it is ignited. The burner might better be called a "mixer," as no combustion necessarily takes place at the "burner."

High-pressure burners have the advantage of greater simplicity and freedom from the effect of variable pressures of the gas or air. Once the proper mixture has been obtained—by whatever method—the rest depends entirely on the design of the furnace. The use of high-pressure gas in preference to air-blast and low-pressure gas has many advantages, the chief of which is that all necessity for an air-blower and air-pipes is done away with. This will be easily understood when I demonstrate to you the working of a high-pressure burner and a high-pressure blow pipe. When gas issues from a nozzle at low pressures, a luminous flame is obtained. As the pressure is increased, the flame gradually loses its luminosity, owing to a more intimate mixture of gas and air being brought about, until a "solid" mass of combusting gases is obtained. There is no inner cone as usually understood. The closest approximation to it is the Méker burner. With high-pressure gas, the velocity of the mixture prevents lighting-back. In the Méker burner, the grid serves this purpose.

When the pressure is further increased, the velocity of the gas becomes too great, and combustion in most cases ceases at the burner and only takes place when the velocity of the mixture has been sufficiently reduced. It is quite possible, as I will show, to bring about combustion in the open air some distance away from the burner. In furnace practice, the brickwork cuts down the velocity. In this case, it is the atmosphere. Means have to be devised to bring about this blow-pipe effect and at the same time retain the flame at the burner. The way this is done may be seen from the blow-pipe I have here to show you. The high-pressure gas is caused to pass through two pipes, each controlled by a cock. The gas escapes from the one through a small orifice at a high velocity. In the other, the gas is allowed to expand and escape through a wide aperture as low-pressure gas. The former gives velocity to the flame; the latter volume. By means of these two simple adjustments, any type of flame that may be desired can be produced. The burners work quite efficiently at any pressure above 3 lbs.; so that they may be run quite efficiently from most high-pressure lighting supplies. This type of flame has many advantages over the usual air-blast pipe. For the same size of flame, it is smaller and lighter in construction. Owing to the method of mixing the gas with the air, the temperature of the flame is much hotter than the air-blast flame. With the air-blast, when the highest temperature is attained the flame is an oxidizing one. At higher temperatures, the high-pressure flame is still a reducing one.

Heating Soldering "Bits."

High-pressure gas can be applied with advantage to soldering iron work. It is usual to warm these appliances in coke-heated stoves by pushing the bits among the incandescent coke. Air-blast heated irons take more gas than when heated with high-pressure gas. The bits become oxidized, and the extra weight of the large gas connection and also the air-pipe makes the appliance cumbersome. Careful tests have been made of the cost of heating up medium-sized "bits" by means of coke and high-pressure gas. These have extended over a period of six months. The costs come out remarkably close. The gas consumption per hour, working at 100 inches of water, but stated as measured at 20/10 inches, is 4 cubic feet. The weight of the bit is 9 oz. With gas at 1s. 3d. per 1000 cubic feet, the cost per 10-hour day per iron is 0·6d. Each iron requires 6·6 lbs. of coke per day. With coke at 16s. 6d. per ton, the cost per iron per day, using coke as fuel, is 0·6d. Although larger irons cost less to heat by means of coke than by high-pressure gas, the increased speed of working with such irons, owing to their always being hot, renders them economically preferable.

Simple Furnace Construction.

Large advances are been made in brass melting in Birmingham, as well as in the melting of many other metals. At this point, it will be profitable, I believe, to consider for a moment what are the principles which must govern all furnace construction if gas-furnaces are to be generally adopted for melting purposes on a large scale. They should be constructed on the simplest lines possible. The furnaces will be used by casters who have not had a technical training; and this fact is the one that usually makes the greatest impression on any one who endeavours to introduce new methods into the casting shop. Needless to say, the brickwork should have a small coefficient of expansion and a low heat conductivity. Nine inches of brickwork is the least that should be allowed; and where possible, the furnaces should be built into the ground.

It should always be possible to drop the bottom out of the furnace. The loose bottom should be simply held, and contain a tapping hole, stopped up by means of a balanced fire-clay bung. In case of a broken pot, the metal will be completely under control. The brickwork should be strong, and stand rough usage with tongs and stirring bars. The highest efficiencies are obtained when the combustion space is reduced to a minimum. Nevertheless, the space round the pot must allow of the tongs being easily manipulated. The brickwork should be so built into the furnace that, when the lining has worn or become fluxed with spilt metal, it can be easily removed and replaced without it being necessary to rebuild the whole furnace. Where standard arched bricks can be used, it is an advantage, as the cost of renewals is an item in furnace practice.

The lighting up and regulation of heats should be under complete control, and capable of easy manipulation by the uninitiated. The human factor should enter into the work as little as possible, and enable it to be carried out quite independent of special men. All variable factors should be reduced to a minimum. One of the advantages of doing away with air-blast is that a variable is abolished. In coke-heated furnaces, there are cool periods and hot periods, depending on when stoking is taking place. These difficulties are abolished in all high-pressure gas furnaces. I have seen furnaces which have been working on full load for nine months. They are lighted each morning, and require no further attention during the day. Small variations in gas pressure make no appreciable difference to the quality of the mixture of air and gas passing through the burner.

Economies in Metal Melting.

In aluminium melting, to which I have referred extensively before, the results which are being obtained are surpassing our most sanguine expectations. Each month brings forth some fresh economy. As is to be expected, each metal to be melted requires its own conditions of melting; and the experience of the last twelve months has much more than justified the application of high-pressure gas to aluminium melting. The most important advance has been in the saving of pots. These are lasting a month now, where before they lasted a fortnight with a smaller daily output. As the cost of pots per ton of metal melted was at one time greater than the cost of gas—it is always so in coke-heated furnaces—it will be easily realized that a great economy has been made in this direction.

In brass melting, however, the greatest advances have been made. This is quite a different proposition from that of aluminium melting. The temperature necessary is higher for brass; but the volume of heat required is lower. In brass melting, there is always the difficulty of the volatile zinc constituent. At the temperature necessary to melt the copper the zinc boils rapidly, and is lost in the flues. The longer the operation of melting takes, the longer is the time during which the zinc is being lost. This almost indicates that high temperature quick heating should be adopted. This is not quite the case. In coke and oil furnaces, I am of the opinion that too high temperatures are employed. This seems to be proved by the fact that in both cases the loss of zinc per ton of metal melted is invariably higher than in gas-heated furnaces. I believe the best practice is found to be to run down the scrap metal at a moderate temperature (about 1050° C.), and then, where necessary, add the ingot copper, which has been previously warmed in the flues, and raise the temperature to 1300° to 1400° C., and maintain it at this heat until the metal reaches the correct degree of fluidity. This may be determined by placing an iron rod in the furnace and listening for the metal to "sing." This occurs when the zinc commences to boil.

With a gas-heated furnace, the gas is then turned off and the extra spelter added and mixed, while the crucible is still in the furnace, with the molten metal. Five minutes is sufficient for this stage. The metal has been slightly cooled down by the addition of the spelter, and is now ready for pouring. The furnace cover is replaced as soon as the pot has been taken out, and the gas only turned on again when the empty pot has been replaced.

Another strong recommendation for gas-heated furnaces, compared with coke, is that where the caster has not got his moulds ready for the metal, with gas the metal may remain in the furnace and the gas only turned on to maintain a sufficient temperature to maintain the requisite fluidity. With coke, no such regulation of temperature is possible; and the spelter would consequently be boiling during the wait.

The question of the regulation of heats, and the consequent effect on the loss of metal, is more important than would at first appear; and too much stress cannot be laid on it. A matter of a difference of 1 per cent. in the quantity of metal lost will make a difference of from 4d. to 7d. per 100 lbs. of metal melted. As the cost of fuel is never more than this figure for brass melting, any slight increase in cost brought about by using gas in place of coke

* See *ante*, p. 606.

is much more than outweighed on this count alone. The increased life of the pots is also a saving. Where 24 heats only were possible with coke, 30 are being obtained in gas-heated furnaces. This reduces the cost for pots from 4·7d. per 100 lbs. of metal melted to 3·75d. The cost of this size of pot (160 lbs.) is 15s. The conditions of melting vary for each type of metal melted. Ingot metal will be different in its results from scrap metal, and both very different from borings. The last is the most troublesome of all. The following are the results obtained while melting scrap brass (60/40). As is well known, most casters prefer the melt to occupy about an hour-and-a-half. This gives them time to prepare their moulds.

This test was carried out in order to determine to what extent this could be done without raising the cost of melting. It is usually possible to complete the melt in about 40 minutes. The increased time has a tendency to increase the amount of metal volatilized. The tests were carried out in a 60-lb. pot furnace, arranged with a single high-pressure burner; the centre line of the burner being fixed a distance of 1 inch from the tangent to the furnace-wall, and at a height of 2½ inches above the furnace-bottom. The burner was fitted with a jet 0·0935 inch in diameter passing about 210 cubic feet of gas per hour at a pressure of 23 inches of mercury. The metal melted consisted of 60/40 pig metal and light scrap; the pig metal being added after the scrap had been completely melted. The pot was a 60-lb. graphite pot.

Results of Test.

Time.	Pressure at Back of Jet.	Consumption Corrected to 20/10 Inches W.	Remarks.
	Inches M.	Cubic Feet per Hour.	
11.0	23·8	210	Furnace lit up.
11.23	,,	,,	Pressure reduced to 15 inches M, Charge 1 commenced. Scrap in.
11.30	15·0	180	Scrap charged. Ingot (14 lbs. 3 ozs.) placed to warm on furnace.
11.35	,,	,,	More scrap charged.
11.40	,,	,,	ditto.
11.47	,,	,,	Small scrap charged.
11.57	,,	,,	Remainder scrap charged.
12.5	,,	,,	14 lbs. 3 ozs. ingot metal charged.
12.14	,,	,,	Metal melted. Pressure reduced to 8·8 inches M.
12.27	8·8	135	Pressure increased to 23·8 inches M.
12.37	23·8	210	Metal poured.
12.40	8·8	135	Charge 2 commenced. Small scrap charged. Ingot put to warm.
12.50	,,	,,	More scrap charged.
12.53	,,	,,	ditto
1.0	,,	,,	More light scrap.
1.20	,,	,,	Remainder scrap charged.
1.35	,,	,,	Ingot added.
1.57	,,	,,	Full pressure on.
2.15	23·8	210	Metal poured. Pressure adjusted to 8·8 inches M.
2.20	8 8	135	Charge 3 commenced. Small scrap charged. Ingot put to warm.
2.30	,,	,,	More scrap charged.
2.35	,,	,,	ditto.
2.53	,,	,,	ditto.
3 0	,,	,,	Remainder of scrap charged.
3.6	,,	,,	Ingot added.
3.23	,,	,,	All metal melted. Pressure full on.
3.35	23·8	210	Metal poured.

Summary of Results of Test.

No. of Heat.	Metal Melted.	Charge.	Time from Initial Charging to Pouring.	Total Gas Used.	Cost per Cwt. Gas at 1s. 4d. per 1000 Cubic Feet.
1	60/40 Brass.	45½ lbs. mixed scrap, 14 lbs. 3 ozs. ingot metal	1 hr. 14 min.	218 c.ft.	6·55d.
2	,,	45½ lbs. mixed scrap, 14 lbs. 1 oz. ingot metal	1 ,, 35 ,,	236 ,,	7·1d.
3	,,	50 lbs. mixed scrap, 43 lbs. 1 oz. ingot metal	1 ,, 15 ,,	184 ,,	5·25d.

Tabulation of Losses.

No. of Heat.	Total Metal Melted.	Total Ingot Metal Produced.	Total Loss.	Loss. Per Cent.
1	59 lbs. 11 ozs.	56 lbs. 0 ozs.	3 lbs. 11 ozs.	6·2
2	59 ,, 9 ,,	55 ,, 8 ,,	4 ,, 1 ,,	6·8
3	63 ,, 1 ,,	58 ,, 4 ,,	4 ,, 13 ,,	7·6*

During the last charge(*), a certain amount of metal fell by accident into the furnace itself; this to a certain extent accounting for the high percentage loss. In all cases, however, the cost of melting and the losses might have been considerably reduced by employing a deeper furnace in which a charging trunk could be used, thus enabling a larger amount of metal to be charged into the furnace at one time, and thereby reducing the heat losses. With this type of metal, the loss with coke-heated furnaces sometimes runs as high as 10 per cent. The time of heating-up the furnace was not calculated in the costs, as the one heating-up is sufficient for the day, and would have to be spread over the eight heats. This would be equivalent to an extra cost per heat of 0·14d.

In the melting of drillings or turnings, fluxes are extensively used. The turnings are previously freed from metallic iron. The losses during melting amount to anything up to 20 per cent. Without a flux, it is practically impossible to get the metal to run together. The usual loss with this metal in a coke-heated furnace is about 12 per cent. There is consequently a saving of over 5 lbs. per 100 lbs. This is worth at least 18d.

Strip-metal casting is an important industry to tackle. Here a higher degree of fluidity of the metal is necessary. The alloy must be absolutely even, as any patchiness in it will be brought out when the metal is rolled.

Results from a Three Days' Run.

The following are the results of a continuous run extending over three days with copper zinc alloys of varying composition, carried out in a cylindrical furnace, taking a 160-lb. graphite pot, of dimensions 32½ inches high by 12½ inches wide. The furnace was heated by means of four high-pressure burners, two on either side, playing tangentially to the inner surface of the furnace-walls. The pot rested on a stand 4 inches high, and the flue (8 inches wide by 5 inches deep) was placed 3 inches from the top of the furnace. The furnace-walls consisted of 9-inch brickwork built of arch bricks. The metal melted in each case consisted of scrap sheet metal, copper ingots, and spelter. The scrap was melted first; the copper ingots being heated in the top of the furnace in readiness for being placed in the pot when all the scrap had been run down. The whole of the melting and the operation of the furnaces was carried out by the chief casters connected with a large firm in Birmingham. The metal was run down into 12-inch ingot-moulds ready for rolling.

Five heats a day were carried out; and these took about 2½ hours less time than is the usual practice in Birmingham. The pot was now at the commencement of the first heat, and fifteen further heats, after these tests, passed through it—making a total of thirty in all. On a seven heat per day basis, the cost of 12s. 4d. per ton would be considerably reduced. The loss in melting amounted to 1·4 lbs. per cwt. The usual loss amounts to an average of 2·2 lbs. There is thus a saving of 0·8 lb. of ingot metal per cwt. The usual cost in Birmingham for melting is about 4½d. per cwt. Their loss in metal is equivalent to 1s. 4½d. per cwt.; while the loss in metal with gas-heated furnaces amounts to 6d. The number of heats per pot is increased by 20 per cent. This means that, instead of costing for pots 5d. per cwt., as in coke-heated furnaces, it costs 4d. per cwt. with gas-furnaces. Balancing up, we find then that the total cost of melting, including pots, loss of metal, and fuel, amounts to 1s. 10d. with gas and 2s. 2d. with coke, made up as follows:

	Gas-Fired Furnaces. s. d.		Coke-Fired Furnaces. s. d.
Cost of pots, per cwt.	0 4	..	0 5
Cost of metal lost, per cwt.	0 10½	..	1 4½
Fuel cost	0 7½	..	0 4½
Total cost	1 10	..	2 2

These figures take no account of the saving in labour costs, the cartage of coke, removal of ashes, and many other extras connected with coke-heated furnaces. The figure given for the cost of melting metal by means of coke is an extremely low one; but in these tests it was the figure we had to compete with.

Results.

No. of Heat.	Metal Melted.	Quantity.	Total Time Furnace Running.	Total Gas Used in Cub. Ft. Corrected to 20/10 Inches W.
		Lbs.	Hrs. Mins.	
1	60/40 Comm. Brass	160	2 3	
2	,,	,,	1 23½	
3	,,	,,	1 15	
4	Special 60/40 Comm. Brass. More new metal	,,	1 10	3520
5	72/28 Tube	,,	1 12½	
6	,,	,,	2 19	
7	,,	,,	1 27	
8	,,	,,	1 18	3262
9	,,	,,	1 9	
10	,,	,,	1 12	
11	62/38 Brass	,,	2 13	
12	,,	,,	1 8	
13	,,	,,	1 13	3165
14	,,	,,	1 5	
15	,,	,,	1 10	

Total metal melted, 2400 lbs. 21·4 cwt.
Total gas used (corrected to 20/10ths water), 9947 (say) 9950 cub. ft.
Total fuel cost, with gas at 1s. 4d. per 1000 feet (9·95 × 16) d.

Average fuel cost per cwt., $\frac{9{\cdot}95 \times 16}{21{\cdot}4}$ d.

= 7·4d. per cwt.
= 12s. 4d. per ton.

Constructional Details.

The following particulars may prove of value to any who are interested in furnace construction. They have been obtained

from actual experience of what we have found to be best, everything taken into consideration. The dimensions are for crucible furnaces for all metals up to German silver.

Distance of the centre-line of the burner from the tangent to the inside of the furnace, 1 inch.
Distance of the centre-line of the burner from the bottom of the furnace, 2½ inches.
Height of the crucible stand, 3 inches.
Flue area, 6 in. by 4 in. tapered to the damper.
Thickness (minimum) of brickwork, 9 inches.

The face of the burner should be in line with the tangent to the furnace, and full way 3 in. by 3 in. allowed from the burner to the furnace interior.

Dimensions.

Crucibles.			Cylindrical Furnace.		Gas Consumption per Hour for Copper.
Capacity. Copper.	Height.	External Diameter at Top.	Interior. Height.	Interior. Diameter.	
Lbs.	Inches.	Inches.	Inches.	Inches.	Cubic Feet.
60	11⅜	7¾	27	10	200
120	15¼	9¾	33	12½	400
140	16¼	10	33	12½	425
160	17½	10¼	33	1 3	450
200	17½	11⅛	33	13¼	490

Low-Pressure Gas for Annealing.

Nearly all annealing is done by means of low-pressure gas rather than with high-pressure gas or with air blast and low-pressure gas. Except where very quick working is necessary, I am of the opinion that low-pressure furnaces are as efficient and more convenient than either of the latter systems. Temperatures of less than 800° C. are all that are required. These may be easily attained in low-pressure gas-furnaces. Their only disadvantage is that they take rather longer (about 33 per cent.) to heat up than blast-furnaces, and when worked to their full capacity their powers of recovery are not so great.

Oven-furnaces are all that could be desired for this work. They are more efficient than the usual type of muffle-furnaces. The presence of the products of combustion in the annealing-chamber tends to prevent oxidation of the metal. The floor slabs are easily replaced, and the oven will stand much harder usage. Under actual use, an oven measuring 2 feet wide, 3 feet deep, and 1 foot high could be heated up to—

Temperature.	Time to Attain.	Gas Consumption per Hour. To Heat Up.	Gas Consumption per Hour. To Maintain.
650° C.	45 mins.	500 cub. ft.	130 cub. ft.
750° ,,	60 ,,	500 ,,	150 ,,
1000° ,,	90 ,,	500 ,,	200 ,,
1300° ,,	180 ,,	500 ,,	500 ,,

Working with medium weight stampings, it has been found that a furnace this size can easily deal with 2·5 cwt. of stampings per hour. At the end of that time, the furnace will have recovered its initial temperature. At this rate of heating, the gas consumption is 73 cubic feet per cwt. of metal annealed; or, with gas at 1s. 6d. per 1000 cubic feet, the cost would be 1·3d. per cwt.

Results from coal-heated ovens are so uneven and so irregular that no reliable figures have been obtained. In by far the majority of cases, the cost with gas is less than the cost with coal. The fuel cost, however, is not the most important item.

In all the work we have dealt with in our high-pressure foundry in Birmingham, no single piece of metal has been spoilt through oxidation or melting during any of the official annealing tests. This speaks remarkably well for the adaptability of this type of furnace. They are evenly heated. There is no fear of oxidation. Under every conceivable set of conditions they have behaved themselves well, and have invariably given entire satisfaction to those for whom the tests have been made.

Essentials to Success: Right Advice, Appliances, and Gas.

I have only mentioned a few of the applications of gas—and especially high-pressure gas—for heating purposes. I have not time to go into details of others. I believe there is no limit to the field of gaseous heating. The chief essentials are cheap gas and constant calorific value—the higher the better.

There is more harm done in giving wrong advice—or, worse still, an appliance wrongly constructed for the work the consumer has to deal with—than can be estimated. Gas-furnaces used to be employed only under special circumstances necessitated by the work. Consequently, the question of efficiencies had less attention than they have nowadays, when the public are realizing that much of the smoke nuisance could be abolished, and gas men are realizing that gas can be made to economically compete with other fuels in many other heating processes which have not yet been touched.

The future for gas is in its further applications for heating. However successful the lighting is, and becomes, from the point of view of consumption, heating and power will be the mainstay of the industry.

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

Parliamentary Authorization of Benefit Funds.

Sir,—Your title and note in reference to the joint action of several important gas companies in connection with the above, prompts me to briefly relate my own experiences with regard to the purposes to which the funds of a statutory concern may be legally applied. I must be careful to point out that the experiences I am about to relate have reference to a Board of Commissioners constituted under a Public Act; but your interrogation as to whether similar action on the part of statutory (sliding-scale) companies is legal or not, is a pertinent one, and may cause some concern among company directorates.

In view of the fact that in a sliding-scale company the consumers' interests are directly affected by every act of the company, and that any moneys they may pay out for extraneous purposes unauthorized by their Act is largely at the expense of the consumer, and only in a smaller degree out of the pockets of the shareholders, there seems to be here an important point for authoritative decision. One can almost read into the Joint Bill referred to the opinion of at least one authority versed in both law and gas administration, that it is not legal to pay out such moneys from the general balance of a gas company.

It will be remembered that during the Boer War the Government then in power recommended employers that not only should the places of Reservists called up to serve with His Majesty's forces in time of war be kept open, but that their dependants should be given some assistance while they were so engaged. Some years prior to this, the Gas Commissioners of Edinburgh had made a contribution from the general funds to the Edinburgh Royal Infirmary. This action on their part was contested by a gas consumer, and the case duly considered by the Court of Session. The Court found that the Commissioners were not entitled to make such a contribution out of their funds, although it was shown that they received considerable benefit from the Infirmary through the persons of their employees. Notwithstanding this decision against them, however, the Gas Commissioners acted upon the suggestion thrown out at the time of the Boer War already referred to, but were conscious that they were acting illegally. In the promotion of a Provisional Order in 1902, they obtained powers to grant allowances to employees (non-contributory); and the total sum so appropriated was not in any year to exceed ½d. per 1000 cubic feet of gas sold, or the allowance to exceed one-half of the amount of wages paid to employees who had been in the service not less a period than twenty years, aggregated, but not necessarily continuous, for the full period of each year, excepting in the case of Reservists, to whom the Commissioners were entitled to make a payment irrespective of their term of service.

For reasons which need not be discussed at this stage, a much broader superannuation scheme was introduced in the year 1908, on the contributory basis, by which means the employees became possessed of certain rights as well as privileges. This scheme was duly reported in your columns at the time. I refer to it now, however, in order to make my last point, which is embodied in clause 36 of the 1908 Order as follows:—

> The Commissioners may out of the revenues of the gas undertaking make an annual contribution to the Edinburgh and Leith Corporations' Gas Commissioners Employees Sick Benefit Society of such amount as they think fit, but so that such annual contribution shall not exceed an amount equal to the total contributions of the members of the fund for the year.

It has not been found necessary to make such a contribution; and pending legislation will probably render it superfluous. The fact, however, stands out quite clearly to the effect that the Commissioners were only entitled to spend money in accordance with their statutory enactments as embodied in their Private and General Acts of Parliament and the Gas-Works Clauses Act, &c.

W. R. Herring.

Palace Chambers, Westminster, S.W., Nov. 27, 1911.

Vertical Retorts.

Sir,—I observe in the current issue of the "Journal" a copy of my report to the Gas Commissioners on various vertical retort installations in England and on the Continent.

I note under the Dessau results at Sunderland 11·25 cwt. is given as the figure for coke obtained per ton of coal, and shall be glad if you will insert in the next number a correction, stating that this should have been 14·29 cwt.

I may add I was rather disappointed to see the above document in print, as at the present moment it is of a semi-private nature.

Alexander Masterton, Engineer and Manager,
Edinburgh and Leith Corporations' Gas Commissioners.

Edinburgh, Dec. 1, 1911.

Proposed Purchase of York Water-Works.—Some time ago, a Special Committee of the York Corporation were appointed to consider the advisability of purchasing the water undertaking; and they have now reported that, after fully going into the matter, they have unanimously come to the decision to recommend the Council to make application to Parliament next year for a Bill to enable them to acquire the Company's works by agreement or, failing that, by arbitration.

Gas Prices and Profits at Barry.—The Barry Urban District Council lately decided to make a reduction of 4d. per 1000 cubic feet in the price of gas, and at the same time to give a sum of over £5000 out of last year's surplus for the relief of the rates. At a meeting of the local Chamber of Trade last week, the latter step was objected to. It was contended that it was giving relief to ratepayers who were not consumers of gas. A proposal was made that the Council should be asked to make a further 10 per cent. reduction; but eventually a Committee were appointed to draw up a report.

LEGAL INTELLIGENCE.

POLLUTION OF A STREAM AND DESTRUCTION OF FISH.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.

Monday, Nov. 27.

(*Before Mr. Justice* NEVILLE.)

Foster v. Charing and District Gas Company, Limited.

As briefly recorded in the "JOURNAL" last Tuesday, this case was concluded to-day,

Mr. JENKINS, K.C., and Mr. HILDESHEIMER (instructed by Messrs. Oliver Richards and Parker) appeared for the plaintiff; and Mr. PETERSON, K.C., and Mr. MANNING (instructed by Messrs. Paterson, Candler, and Sykes, agents for Messrs. Ellis and Ellis, of Maidstone) represented the defendants.

Mr. PETERSON produced and handed up the rough notebook referred to by the witness Marshall, which he thought had been destroyed.

Fred W. Harling, a police-sergeant stationed at Charing since 1908, spoke to the condition of the gasholder tank, which he said was always full of water. He saw Marshall pumping it on the night of Oct. 3, and on one or two subsequent nights. There was no smell of ammonia.

Mr. *C. H. Cribb*, B.Sc., late Vice-President of the Society of Public Analysts, gave the results of analyses of a dead trout, a dead jack, and samples of water, sheep dip, and chloride of lime. The analysis of water showed in 100,000 parts: Solids in suspension, organic, 9·3; do., inorganic, 10; do. in solution, organic, 152; do., inorganic, 27·2; ammonia, free, 13·5; do., albuminoid, 6·5. He explained that free ammonia was given off when the water was boiled after the addition of alkali. There was no trace of tar. The normal amount of ammonia in gas liquor was 2·25 per cent. Raw sewage contained 6 to 10 parts per 100,000 of ammonia. After treatment, it was much reduced, depending on the method employed. Ammonia would not discolour an ordinary stream, and did not produce any scum, froth, or iridescence on the surface. He knew no reason why water such as that which he analyzed should not pass into sewage works. There was no sulphuretted hydrogen in the water. He said he had seen the sewage works at Charing; and he described the process employed there. Taking the quantity of water pumped from the tank to be 800 gallons per day, it would be diluted 30 times when it entered the valve chamber, again when it left the works and mixed with the spring water, again when it entered the brook, and once more when it entered the Stour, by which time, when the river was running full, the quantity per 100,000 would be 0·00044 part, or if the river were very low 0·0011 part. If the quantity pumped daily were 4800 gallons instead of 800 gallons, of course, the quantities would be multiplied by 6—viz., 0·00264 or 0·0066. The largest of these proportions would be quite impossible to be fatal to fish life. In one sample of sheep-dip he found sulphate of copper, and in the other arsenic. In the chloride of lime he found 1·04 per cent. of available chlorine; and, owing to decomposition, it had become strongly alkaline, equal to 17·5 per cent. of calcium hydrate.

Cross-examined: He made a report on the analysis of the fish, to the effect that the results were negative. The details of the water analysis were first given to Mr. Ball in October last; but he had previously informed him of the general result. Any black effluent, such as had been spoken to by one witness, could not have been caused by the water he analyzed. A quantity of ammonia was formed in the septic tank in the sewage-works by the action of bacteria on the nitrogenous matter. This was the object of the tank. It was possible, as Dr. Gardiner had said, that 7·3 parts of free ammonia per 100,000 might kill fish; and in his experiment it did so. He had not made any such experiments himself, first because he had not sufficient liquid, and secondly because he had no licence for vivisection.

Re-examined: The ammonia in the sewage was converted into nitrites and nitrates on the contact beds, and they were harmless.

This concluded the defendants' evidence.

Mr. Justice NEVILLE asked if it was desired that he should assess the damages, supposing he were in the plaintiff's favour.

Mr. JENKINS said he should prefer this course; but if his Lordship had any difficulty, there might be an inquiry.

Mr. Justice NEVILLE asked further if the plaintiff could recover both damages and penalties.

Mr. JENKINS thought he could. Half the penalty would have to go to the Local Authority; and it might be that the other half would properly go in reduction of the damages. His client, however, did not wish to be vindictive, and would waive any question of penalties.

Mr. PETERSON then submitted that, on the evidence, the salient portions of which he commented upon, it was quite impossible that the injury complained of could have been caused by anything coming from the gas-works.

Mr. MANNING added a few words to the effect that the onus was on the plaintiff, and that he had not discharged it.

Judgment.

Mr. Justice NEVILLE, without calling for a reply from plaintiff's Counsel, said he had come to the conclusion that the injury to the fish in the river was caused by the discharge from the defendants' works. The evidence for the plaintiff was very definite and precise; and he did not think it had been displaced by the defendants. He could not accept the evidence of Marshall, who, he believed, was trying to conceal something; and it was very probable, in his opinion, that more water had been pumped from the tank into the drain than had been represented. Further, he was not satisfied that the sample of water sent for analysis fairly represented the water in the tank. It was probably taken from the surface, or near it; and the condition lower down might have been quite different and might have contained something, apart from ammonia, which was deleterious. He must grant an injunction, and direct an inquiry as to damages, the costs of which would await the result. The defendants must pay the costs of the action.

MISCELLANEOUS NEWS.

CITY OF LONDON PUBLIC LIGHTING.

Combined Gas and Electricity Scheme Adopted.

At the Meeting of the Court of Common Council of the City of London on Thursday last, the Streets Committee presented the following report on the subject of the public lighting.

It will be in the recollection of your honourable Court that on July 1, 1909, we submitted the report of the deputation appointed in October, 1908, to visit certain Continental cities for the purpose of inspecting the various systems of public lighting,* with the following conclusions at which they arrived:

1.—That, wherever possible, streets should be lighted by means of centrally-hung lamps with lowering gear.
2.—That open spaces should be lighted by means of lamps upon standards, fitted with lowering gear.
3.—That high-pressure incandescent gas-lamps with inverted burners should be adopted as the illuminant; but where gas is impracticable, electricity with open arc and flame arc lamps should be installed.

Without offering any opinion on the report, we asked that it might be printed and circulated among the members; and on Oct. 21, 1909, you authorized us to arrange for further experimental lighting, with the result that on Feb. 17, 1910, offers of the City of London Electric Lighting Company and of the Gaslight and Coke Company to make further experiments on the lines suggested in the deputation's report, at a cost of £525 per annum and £360 per annum respectively, were accepted. These experiments have since been in operation in Cheapside and in Cannon Street by King William Street. The present cost of lighting the streets of the City with gas is £10,099, and by electricity £10,774; making together an annual charge of £20,873.

We have since approached the Gas and Electric Lighting Companies with a view to arrangements being made for lighting the City in about equal proportions by gas and electricity, by means of centrally-hung lamps as far as practicable; and, having very carefully considered the matter, we submit a scheme and plan for lighting the streets of the City accordingly. We recommend that the Gaslight and Coke Company and the City of London Electric Lighting Company be permitted to light the public ways in accordance with the scheme, and that it be referred back to us with power to settle all necessary details and to arrange accordingly. By this arrangement, an annual saving of £6830—viz., gas about £3380, and electricity about £3450—will be effected on the cost of public lighting, and an increase in illuminating power of about 600,000-candle power obtained.

Mr. J. GUNTON said he moved the adoption of the report with all possible pleasure, because he occupied an enviable position. He had frequently to submit reports which involved improvements; but in this instance he had to put before the Court a matter which entailed great benefits, and at the same time would not only be of no great cost, but would, in fact, entail a saving of several thousands of pounds a year. In October, 1908, as would be remembered, a deputation was appointed, consisting of five, of which number he was one; and they visited the chief Continental cities for the purpose of observing the systems of lighting adopted there. They found that, in their opinion, on the Continent there was a better system of lighting the streets than that which was in operation in London. As a consequence of their observations, they reported to the Court, making three main points—first, that wherever possible London streets should be lighted by means of centrally-hung lamps with lowering gear; secondly, that open spaces should be lighted with standard lamps with lowering gear; and, thirdly, that the lighting be by means of high-pressure incandescent gas-lamps or, where impracticable, by electricity with the open arc or flame arc lamps. The Committee had since been experimenting with these lamps—at the St. Paul's end of Cheapside with electric lamps, and in Cannon Street with high-pressure gas-lamps of 2000-candle power. The results of the experiments had been very satisfactory, and the people who used the streets a great deal very much appreciated, and were unanimously in favour of, the centrally-hung lamps. The chief point in their favour was that they did not throw any shadow. The Committee had been instructed to obtain tenders for the lighting of the streets from the two Companies concerned; but neither of them was willing to tender for the whole of the lighting by reason of the cost. The Committee were therefore submitting a scheme for half gas and half electric lighting. An urgent reason in favour of this proceeding was that in certain streets—some of the most important ones—there were no gas-mains, and to instal gas would mean the taking-up of the whole of the streets affected. This was impracticable. The results of the tenders submitted had been as follows: For centrally-hung lamps wherever possible, and where not practicable for standard lamps, the Gas Company quoted £6719, against the present £10,099; and the Electric Lighting Company quoted £7322, against £10,774—making a total of £14,041 as against £20,873, or a saving of £6832 a year. But, whatever the result might be, this was not the object of the scheme. The Committee's idea was to obtain a better system of lighting the streets; and by the new scheme they obtained an increase of 601,755-candle power. They had prepared a complete lighting scheme for the streets throughout the City, and all would be in the same area. Where it had been found impracticable to put central lamps, they were having standards. There had been mentioned as an objection that there was a danger of a centrally-hung lamp falling; but, from inquiries made in Continental cities, they found that only one case of the kind had occurred, and it did not result in any person being hurt. The reason of the safety was that the lamps were connected by means of the wire to the side wall; and by a simple arrangement they could be lowered to the pavement in order to be cleaned and repaired. Another good

* See "JOURNAL," Vol. CVII., p. 175.

point about the central hanging was that it would be particularly advantageous in narrow streets. From all points of view, the Committee felt that the suggested system would be advantageous, as it would effect a vast improvement in the lighting of the public thoroughfares with the largest possible saving and a minimum disturbance of the streets.

The report was adopted *nem. con.*

The Area to be Lighted.

The following are the streets to be lighted by centrally-hung lamps:

Gas.—Arthur Street East, Cannon Street (eastern end and central), Fish Street Hill, Fleet Street, Golden Lane, Lower Thames Street (part), Monument Street, and Queen Street (from Queen Victoria Street to Cheapside).

Electricity.—Aldersgate Street, Aldgate, Aldgate High Street, Arthur Street, Barbican, Beech Street, Bishopsgate, Billiter Street, Blomfield Street, Cannon Street (western end), Cheapside, Coleman Street, Cornhill, Eastcheap, Eldon Street, Fenchurch Street, Finsbury Pavement, Fore Street, Giltspur Street, Gracechurch Street, Gresham Street, Great Tower Street, Holborn Viaduct, Houndsditch, Jewin Street, King Street (Cheapside), King William Street, Leadenhall Street, Lloyd's Avenue, Lombard Street (part), London Wall (eastend), Long Lane, Lothbury, Lower Thames Street (part), Ludgate Hill, Middlesex Street, Minories, Moorgate Street, New Broad Street, Newgate Street, Old Bailey, Old Broad Street, Poultry, Princes Street, Queen Street (from bridge to Cannon Street), Red Cross Street, Shoe Lane (part), South Place, Snow Hill, St. Andrew's Street, St. Bride Street, St. Mary Axe, Threadneedle Street, Upper Thames Street, Watling Street, and Wormwood Street.

In addition, there will be high gas lighting on columns in the following main thoroughfares: Queen Victoria Street, 43 2000-candle power lamps; New Bridge Street, 2000-candle power lamps; Mansion House Street, 3000-candle power lamps; Lombard Street (part), 2000-candle power lamps; and on the lavatories in front of the Royal Exchange and Gracechurch Street.

Attachment of Brackets to Buildings.

It appears that a question arose as to the power of the Corporation to affix to the external walls of buildings fronting streets brackets and other appliances for the public lighting. This point has been carefully investigated by the Streets Committee, more particularly in view of certain objections raised against the affixing of the apparatus for lowering the lamps; and, upon legal advice, it has been decided that section 58 of the City of London (Various Powers) Act, 1900, meets the case. It is there explicitly set forth that the Corporation may affix to the external wall of any building fronting any street within the City (Crown and Government buildings excepted) any "brackets, wires, pipes, lamps, and apparatus as may be necessary or convenient for the public lighting of streets within the City." The Corporation are to make compensation to any person sustaining injury by their action; the amount to be determined, in default of agreement, by arbitration under the Arbitration Act, 1889.

NOTTINGHAM GAS-WORKS ENGINEERING APPOINTMENT.

At a Meeting of the Nottingham City Council yesterday—under the presidency of the Mayor, Mr. E. Mellor—a report was presented by the Gas Committee recommending the appointment as Engineer and Manager of the Corporation gas undertaking of Mr. John Wilkinson, of Halifax, to fill the vacancy caused by the resignation of Mr. J. H. Brown, who filled the position for nearly nine years.

The report explained that, in response to advertisements in the professional journals, some sixty applications were received; and, after the number had been reduced to four, the Chairman made a personal "supervise" visit to the works of the applicants from a distance. The Committee, after due consideration, had no hesitation in arriving at the conclusion that the appointment of Mr. Wilkinson would be most desirable in the interests of the undertaking. Mr. Wilkinson had been Engineer and Manager of the Halifax Gas-Works for eight-and-a-half years. Before that he was Works Manager at the Grimesthorpe Gas and Chemical Works of the Sheffield United Gas Company; and he had had fifteen years' previous experience in the profession. The salary at Nottingham had been fixed at £1000 per annum—being the same amount as was paid to the late Engineer. The Committee had stipulated that Mr. Wilkinson should give the whole of his time to the service of the Corporation; that he should not take pupils without the consent of the Committee; that he will not be permitted to have any other occupation or business whatsoever, nor to receive any commission or fees. It was also a condition of the appointment that he should not advise any other Corporation or any firm or person carrying on the business of a gas or chemical undertaking.

The Chairman of the Gas Committee (Mr. Albert Ball), in moving the appointment of Mr. Wilkinson, said it was important that the Corporation should obtain the very best man for the position. When some years ago the salary offered was £750 per annum, it was surprising to find the class of applicants they had. It was possible for the engineer to make large profits, or by one mistake to incur heavy losses. At Halifax, where the works were only half the size of those at Nottingham, Mr. Wilkinson was getting £700 per annum, and was allowed to do consulting work; the latter bringing up his total earnings to considerably more than the amount now offered. But he was satisfied to accept the Nottingham appointment, which was looked upon as one of the "blue ribbons" of the gas profession. The Gas Committee of the Halifax Corporation had such confidence in him that they had offered him a substantial increase to remain with them. He attended the meeting of the Committee on the previous Friday, and expressed his readiness to accept the position. Mr. Ball added his conviction that it would be for the benefit of the ratepayers to secure Mr. Wilkinson's services, and that he would prove one of the most practical engineers Nottingham had ever had.

The report was adopted.

THE LIMITATION OF GAS PROFITS.

A Conference in London.

A Meeting was held last Thursday afternoon, at the Westminster Palace Hotel, S.W., of representatives of a considerable number of the large towns owning gas undertakings. The proceedings were private; but at the conclusion of the deliberations, a representative of the "JOURNAL" was informed that the gathering had been convened by the Salford Corporation to consider the policy to be adopted by those municipalities who have gas-works under their charge, in connection with the Bill which is being promoted by three Local Authorities of districts outside the borough of Salford, but within the area of gas supply of the Salford Corporation.

This Bill is being promoted by the Local Authorities referred to in order to enable the Salford Corporation to carry out the objects of their Bill of 1909, which went before a Committee of the House of Lords presided over by Lord Donoughmore, and the preamble of which was passed—but only on condition that the Salford Corporation did not apply to the relief of rates an amount representing more than 1 per cent. on the outstanding capital. The Salford Corporation, in preference to accepting this decision, withdrew the Bill; and the three Local Authorities are now desirous of promoting it with the addition of a clause limiting profits to 1 per cent. on the outstanding capital. The Salford Corporation, on the other hand, have given notice of a Bill similar to that promoted by them in 1909.

The object of Thursday's meeting was to ascertain whether the other municipalities were prepared to support the Salford Corporation. Alderman Phillips, the Chairman of the Salford Gas Committee, presided; and those present included Sir Charles Petrie, who attended on behalf of Liverpool, and Sir Hallewell Rogers, the Chairman of the Birmingham Corporation Gas Committee, who represented that city. Mr. Balfour Browne, K.C., and the Hon. J. D. Fitzgerald, K.C., advised the conference generally on the matter under discussion.

All those who were present at the conference expressed the view that the Salford Corporation ought to fight strenuously against any such limitation of the profits as 1 per cent. on the outstanding capital, and agreed that, in the event of Salford going forward with their Bill, they would support the Corporation by every possible means, and would resist the proposal of the Local Authorities. The following resolution was passed by the conference: "That this meeting is strongly opposed to the principle of any limitation of the amount of profits to be made by municipal gas undertakings, and asks representatives of Barrow-in-Furness, Birmingham, Bolton, Leeds, Leicester, and Liverpool to meet as a Sub-Committee to consider and take such steps in the matter as they may consider necessary, and to report to a future meeting of this conference."

THE ALLEGED MISAPPROPRIATION OF GAS AT FALKIRK.

On Thursday of last week, Sheriff Substitute Moffatt heard the Agents for the parties upon the evidence recently led in the prosecution by the Corporation of Falkirk of Bailie H. Russell, a member of the Corporation, on a charge of having unauthorizedly used gas for lighting purposes which was supplied to him for power (*ante*, pp. 328, 546). Mr. Black, the Solicitor for the Corporation, argued that the actings of the respondent in the matter could be construed to amount to a fraudulent use of gas under the section of the Act founded upon. When a person had been twelve years in the Town Council, had been five years Convener of the Gas-Works Committee, and had taken a great interest in the gas undertaking, it was impossible to believe he did not understand he was doing wrong when he made this unauthorized connection through the power meter. Mr. J. W. Gibson, for the respondent, pointed out that, in a case of this sort, the Court was entitled to the best evidence which could be got; but they had not even before them a resolution of the Town Council as to the imposition of the gas-rates. His Lordship would have to consider also whether the Town Council were not barred in this prosecution by reason of gas being used for lighting purposes from a power meter at the Burgh stables. The charge must be brought up to one of felonious intent. He maintained that it was absolutely improbable that a man consuming gas to the amount of £100 a year should have fraudulent intention in the making of a connection which would only save him a little over 6d. in that year. There was nothing fraudulent, or nothing even irregular, in having sufficient light in a reasonable way to get advantage of the power. He therefore maintained that, keeping in view the necessity there was of proving criminality, the respondent had completely met the charge which had been made against him, and that the prosecution failed. Judgment was reserved.

Falmouth Public Lighting.—At the meeting of the Falmouth Town Council last Thursday, the Lighting Committee recommended the renewal of the contract with the Gas Company for the public lighting for four years from Jan. 1, 1912, on the same terms and conditions as before. A member remarked that sometimes they found the lamps very dull, and he asked if there was any guarantee as to the gas being up to a particular standard. The Town Clerk replied that the Company had agreed to supply gas of 14-candle power. It was arranged that the Sanitary Inspector should pay periodical visits to the gas-works to see that everything was in order; and the corporate seal was then affixed to the contract.

GAS CHARGES AT MANCHESTER.

There are two proposals before the Manchester City Council for a reduction in the price of gas; but our local correspondent thinks it not at all likely that any alteration will be made till the beginning of next year, when the estimates of the Gas Department will be submitted for consideration. In fact, there is, he says, a promise given to the advocates on the Council of cheaper gas that the whole subject of gas charges will be dealt with by the Gas Committee before the estimates are finally settled for the next financial year; and the general impression is that a solution of the whole subject will be found in the adoption of a sliding-scale of charges—extended concessions being offered to large consumers of gas for heating and power purposes.

At last Friday's meeting of the Gas Committee, Alderman G. K. Ashton brought forward his motion to the effect that, from January next, all consumers, both within and outside the city, be allowed a rebate of 3d. per 1000 cubic feet on the amount charged, if the annual consumption on the same premises for any purpose (other than for gas-engines) is not less than 500,000 cubic feet. It having been explained to Alderman Ashton that it would be difficult to give effect to his proposition so near the close of the financial year; and an assurance being given to him that the question of gas charges generally would be considered early in 1912, it was agreed that the matter should be deferred.

Mr. Hoyle has given notice to the Town Clerk that at the next meeting of the City Council he will move that it be an instruction to the Gas Committee to consider and report as to the advisability of reducing the price of gas to all consumers who are at present charged at a higher rate than 1s. 9d. per 1000 cubic feet. At present, the price to ordinary consumers within the city is 2s. 3d., and outside the city area 2s. 6d.; while for gas-engines the charge is 1s. 9d. within and 2s. beyond the city. Should the proposal find favour, it will mean roughly a loss of revenue equal to a rate of 3d. in the pound in the city. Every penny taken off the price of gas in Manchester means a decrease of £25,000 in revenue.

SALFORD GAS BILL.

Suggested Town's Meeting.

The Salford Ratepayers' Association Executive have sent a communication to the Mayor (Alderman H. Linsley) asking that a town's meeting be called to consider the position arising out of the decision of the Corporation to promote a Bill dealing chiefly with the gas undertaking. This request is followed up by a long printed statement, signed Mr. J. W. Cooke, the Chairman of the Association, and Mr. Charles Smith, the Secretary.

It is set out that the Association are of opinion that the promotion of the Bill is "an unwise proceeding, and will involve needless waste of public money." Further, it is argued that if the out-townships had been approached, and not ignored, a fair compromise might have resulted on much better terms than Lord Donoughmore's Committee directed. After stating that the cost to all parties concerned will be not less than £10,000, the statement proceeds: "Apart from mere considerations, on a basis of sound trading, the present declared profits are fictitious, because, if adequate depreciation funds had been established, they would have no existence in fact; so that a small actual profit will leave the ratepayers in a better position than they are at present. In all trading departments, the general body of ratepayers, on whose credit all moneys are borrowed, should be first considered; and we are of opinion that not less than 3 per cent. return should be secured on capital involved, which profit should be devoted to general purposes for the benefit of the whole community. A fair proportion of these profits should surely go to the people who run the risk of the loss. We hope and believe that the out-townships will accept the reasonableness of this position. They simply want to know what is the limit of our profits, and where they come in for a reduction of charges."

Special Committee Suggested.

Councillor Bescoby has given notice that he will move the adoption of the following resolution at the Council meeting to-morrow (Wednesday): "That a Special Committee, consisting of five members—namely, the Mayor (Alderman Lindley), Sir William Stephens, and Aldermen Desquesnes, Huddart, and Jackson—be now appointed to meet the representatives of the out-district, to discuss the gas question, with a view to arriving at a satisfactory basis of agreement—such Committee to report their recommendations to the Council at an early date."

LANCASTER AND GAS PROFITS.

At the Monthly Meeting of the Lancaster Town Council last Wednesday, some reference was made to the conference of representatives of municipalities in London of which some notice appears on the opposite page.

In moving the confirmation of the minutes of the Finance Committee, Alderman Preston stated that the Council had received a long letter from the Town Clerk of Salford, calling a joint conference on gas profits. The Corporation of Salford had made considerable profits (something like £25,000 a year being handed over from the gas undertaking in relief of the rates); and they did not want to lose them. The House of Lords had decided that the Corporation, if they borrowed any more money, must only take a profit of 1 per cent. on the unredeemed capital. Thus if the capital was redeemed altogether, there would be no profit at all. The Corporation had withdrawn their Bill, as they would not proceed on such lines. The matter was now being revived; and the Corporation had written to the various corporations asking them to protest against the way in which they had been treated. The Lancaster gas undertaking was brought from a private Company in 1880. At that time the charge for gas was 4s. 3d. per 1000 cubic feet net. The Company made large profits; but they were restricted by law to 10 per cent. on the capital. The Corporation gave a considerable price for the undertaking, and for at least ten years derived no profit at all from it. The price of gas was gradually reduced, until now it stood at 1s. 11d. per 1000 cubic feet net. Of course, some people argued that the price should go still further down; but there was another side. To say the ratepayers, who provided the capital and stood the risk, should only have 1 per cent. profit on the unredeemed capital, did not seem quite adequate; and Lancaster suggested (if the existing freedom of action could not be maintained) that there should be 5 per cent. profit allowed.

THE HOTEL EXPLOSION AT NOTTINGHAM.

A Theory as to the Cause—An Unsuspected Electrical Peril.

The explosion which recently wrecked the Albert Hotel, Nottingham, to which reference was made in the "JOURNAL" last week, gave rise to a good deal of speculation as to the cause. With the view of obtaining something like an authoritative opinion on the matter, Professor F. S. Kipping, D.Sc., the Chief of the Department of Chemistry and Metallurgy at the Nottingham University College, was interviewed. He said he considered that only two causes could have produced the explosion. One was an escape of gas, and its ignition by a momentary spark caused by the fusing of an electric wire; but he thought if there had been an escape of sufficient extent to cause an explosion of the violence of the one in question, the smell would have been detected. The other cause was an accumulation of electrolytic gas. This gas would be generated by a strong current of electricity passing through water or moisture such as was likely to be found in the earth. The water present would at once become converted into the two gases oxygen and hydrogen. The compound water, in other words, would be split up into its two elements in the proportions of two volumes of hydrogen to one of oxygen. This was a highly-explosive mixture, and the introduction of a light or spark would cause an instant explosion. He thought that whether or not this was an explanation of the Albert Hotel explosion depended upon whether Nottingham had an alternating or a continuous current electricity supply.

According to the "Nottingham Daily Express," the most minute inquiry into all the attendant circumstances of the disaster has failed to disclose any simple explanation of the explosion. The theory of a leakage of gas in the cellars having been ignited either by the fusing of the electric cable or by the firemen's torches is quite discarded. The closest tests of the gas-pipes, even after the explosion, shows them to be perfectly sound and without the slightest leak. That the trouble arose in the first case through the electricity cable is undoubted; but how either a leakage of current or a fusing of the cable could bring about so violent an explosion, is difficult to explain. A very feasible, but at the same time a startling theory, is suggested by the following story of the incidents which immediately preceded the eruption, as related to the representative of the above-named paper by Mr. J. Hendry.

Mr. Hendry, with others, was attracted to the spot by the arrival of the fire-engine, and watched closely the whole of the operations of the workmen from the Electricity Department. Black, pungent smoke was issuing from beneath the flagstones along the whole length of the pavement in front of the hotel, and also from the cellar gratings. The workmen first took off the covering of the section box immediately in front of the main entrance to the hotel; but when they attempted to prise off the iron lid of the box, they found it could not be done, though a crowbar was used. The iron box was then red hot and glowing, and the heat had so expanded the lid as to fix it solidly in its frame. From one corner, however, a thin, blue flame about 8 inches long was issuing, evidently being forced through a tiny crevice by very high pressure. The electricity workmen subsequently turned their attention to another section box, about 15 yards farther along the pavement. They took off the cover, and almost immediately, after a lapse of only two or three seconds, there was a flash, which seemed to go straight into the stooping electrician's face. He fell backwards, but was not injured. There was a distinct interval—two or three seconds—then the pavement, 6 or 7 yards from where the flash occurred, blew up, and immediately following the explosion came another small flash. Mr. Hendry said he did not think the flash which came from the cable box was an electric flash. He has seen cables short-circuit many times; but this was not of the same vivid, blinding nature. He believed it to be the flame from some gas or material burning in the box or in the conduit.

From the account of the condition of the section box opposite the hotel, and the manner in which burning gaseous matter was being forced from it, the theory is advanced that the box was thus transformed into a big bomb or cartridge buried in the pavement, and that it was the ultimate bursting of this box that shattered the place. It is significant that the greatest force obviously was exerted directly under the pavement; otherwise it is hardly likely that the 30 inches of concrete which covered the cellars would have been lifted off while any of the interior walls and flooring remained.

In concluding their story, the "Express" remarked that, should it be found that this actually is the explanation of the mystery, "a startling and hitherto unsuspected peril exists throughout the present electricity system." Certainly, the whole question is one which requires the very closest investigation and study, for what occurred at the Albert Hotel might happen at any moment in any part of the city; and under less favourable conditions the lives of scores might be sacrificed.

High-Pressure Gas Lighting in Leeds.—At last Tuesday's meeting of the Gas Committee of the Leeds Corporation, the Engineer and General Manager (Mr. R. H. Townsley) reported that the experimental installation of high-pressure lighting had been completed in Calverley Street, Duncan Street, and New Market Street, and was regarded as highly satisfactory.

ORIENTAL GAS COMPANY, LIMITED.

Increased Revenue—A Broadened Business Basis.

The Ordinary General Meeting of this Company was held on Wednesday last, at the London Offices, Finsbury House, Blomfield Street, E.C.—Mr. H. D. ELLIS in the chair.

The SECRETARY (Mr. H. J. Luff) read the notice convening the meeting; and the Directors' report and the statement of accounts were taken as read.

The CHAIRMAN, in moving the adoption of the report and accounts, said he should have to make a few observations in submitting them to the notice of the proprietors; and he congratulated himself, and the proprietors still more, upon the fact that he should not have to detain them at the length he did last November. There was not so much novelty this year as then. Taking first the accounts. On the credit side of the revenue account, it would be seen that the income for the year amounted to £102,335. Since the year 1902, when the statement of accounts was converted first of all from rupees into sterling, at the rate of 16d. to the rupee, this was the first time they had attained the magnitude of these figures. Prior to that date, for many years the accounts were stated in the ratio of 2s. to the rupee, which, ages ago, was not only the nominal value of the rupee, but the actual. Indeed, he might mention that, when he went to India some fifty odd years ago, the value of silver was so high (he thought it was 63d. per oz.), that the rupee was worth actually more than the 2s. that passed currency. However, silver fell; and after that, the rupee dropped, until in 1902, in accordance with the general practice, in Indian departments and commercial enterprises, the Directors resolved to put the accounts on the basis that was more consistent with the true currency, and state them on the ratio of 16d. to the rupee. In that year—1902—the revenue was £72,317; so that it would be seen that in the nine years that had elapsed since then, the revenue had increased by no less than 41½ per cent., and this, without a single penny piece having been charged to capital account, for all extensions had been provided out of revenue. This, he thought, the proprietors would regard as a very satisfactory matter. Then, analyzing the revenue side of the account, the gas-rental had realized £80,232. This also was an unprecedented figure. They had never touched £80,000 before; and as the Directors said in the report, a large proportion of the increase was derived from private lighting. Now the stability of a commercial enterprise of this kind, like that of a building, was best assured when it rested on a broad base; and the constant aim and object of the Directors had been to broaden and extend the basis by spreading it over as many of the population of Calcutta as they could possibly make customers of. The Company held out inducement to them, by finding out what they wanted, and supplying them with it; and they tried to merit their patronage and goodwill by purveying the best possible article at the lowest possible price. This was business; and the Directors meant business. The residual products, as mentioned in the report, had also realized an increase, bringing, with the gas revenue, the total up to the six figures which he had already mentioned. Turning to the expenditure side of the account, it would be seen that more had been spent for coal, purification, and wages than in 1910. This, of course, was only the normal increase. The Company had made more gas, coke, and tar, and had sold them; and consequently they had carbonized more coal. But he was happy to say the price per ton of coal was less in 1911 than in 1910. Salaries in India and in London also exhibited a slight increase. It would be remembered that the Directors told the proprietors last year that they were sending out, and had in fact sent out, two additions to the English staff in Calcutta. Their salaries were included in the increased item. He might tell the proprietors, while on the subject, that the Board had further considered the English staff out there, and had resolved that it was expedient to send out two more gentlemen to reinforce it. The Directors were perfectly convinced that this was sound and good economy; and that anything like cheese-paring or niggardly dealing with the numerical power of the English staff would not redound to the advantage of the Company. Also important were the items mains, meters, services, and fittings, £17,078, and wear and tear of works, £12,584. It would be observed that the first item was £5100 less than the same item last year; the second item was £2500 more. The short and simple explanation was that, whereas in 1910 the chief expenditure was outside the works in distribution and main-laying, this year a large proportion was inside the works in the manufacturing department. But aggregating the two items, and comparing them with the corresponding aggregate for 1910, the expenditure upon the two had been £2600 less this year. General expenses showed an increase. The sum contained a large number of items which could only be grouped under general expenses; but this year there were one or two extraordinary items which would not recur in the current year, and which he need not elaborate on this occasion. The result of the trading, as would be observed, was that the year's profits amounted to £24,473. This they carried to the credit of profit and loss account, and added it to the sum brought forward from last year, and to the dividends on investments, and it yielded a total of £35,612. Charged against this was the interim dividend paid in May last, and the other items set forth on the other side of the account—the result being a balance of £22,115 available for dividend. Out of this, the Directors proposed to offer the proprietors the usual dividend of 4½ per cent.—making 8 per cent. for the year. After the payment of this dividend, they would have a balance to carry forward to the current year's operations of £8615. The Directors regarded the accounts with great satisfaction. Indeed, they induced in the Board a little feeling of sentiment and pride, which perhaps was not an unpardonable thing under the circumstances. Be that as it may, there were the accounts; and the Directors trusted and believed they would be as gratifying to the proprietors as to the Board. So much for the accounts. Passing to the report, the Directors told the proprietors of the mission of Mr. Jacques Abady to Calcutta. As most of them were aware, Mr. Abady was well known throughout gas circles in the United Kingdom as a past-master in all that appertained to the science of the lighting of streets and other open spaces. Mr. Abady went out as a fresh man, as he (the Chairman) might say—unbiassed by local prejudices and local predilections; with his eyes open, and undimmed by long familiarity with the scene—with a clear receptive mind to observe. He did observe; and he rapidly grasped the subject in all its bearings. He (the Chairman) need not tell the proprietors that his reports were most interesting, and most valuable to them. Moreover, it was evident that his thorough mastery of the subject, coupled with his courteous demeanour, recommended him especially to the Corporation as a *persona gratâ*. They received Mr. Abady as a welcome envoy and representative of the Company. The negotiations with the Corporation proceeded smoothly, and were concluded, as he verily believed, to the satisfaction of both the high contracting parties. The establishing of harmonious relations with the Corporation was a matter which the Board had always had very closely at heart. These relations now existed; and it would be the endeavour of the Board to do all in their power to maintain the present relations, and not only to maintain them, but to extend and consolidate them. With regard to the operations, he did not propose to take the proprietors laboriously through them. As he said, there was little of novelty in them. The policy of the Directors and their plans were fully set forth to the proprietors this time last year; and then they approved of them. The Board had adhered to this policy and their plans; and they had pushed forward the completion of the work with all the vigour that they were able to bring to bear upon them. They had laid about 45 miles of mains, of which about 10 miles were relay work. The other 35 miles were new extensions. This included the last section of their great high-pressure steel main, which the proprietors would remember he told them last November was to feed the ordinary trunk mains of the city at various points. Then the other principal operation was that of the new retort-house. It would be recollected that he informed them the Board were going to put up a new retort-house, with regenerative settings, and the latest type of stoking machinery, so that the works might be thoroughly up-to-date from the manufacturing point of view. This operation had been pushed forward very strenuously; and the first section was completed, and he believed was actually now in service. Their Manager, in his annual report, stated that the work had been carried out in a very satisfactory manner; and taking into consideration the difficulties that had been encountered, the work had been accomplished in almost record time. Their Manager concluded by expressing his confidence that the new retorts would effect improved results and considerable economies in the working. The next item had reference to the postponing of the new public lighting contract; but this was sufficiently set forth in the report, so that he need not take up time by further reference to it. While on the subject of contracts, he might mention that the Board had recently completed with the Government of Bengal a new contract for ten years, from May 1 next, for the lighting of the Maidan, and this would represent a matter of probably not far short of 1000 lamps—say, 900. This was a gratifying thing. They had not only a new contract with the Corporation, but had extended their contract with the Government. He did not think he need detain the proprietors at any further length, except to thank them for the indulgence with which they had listened to him.

Mr. ROBERT MILLER seconded the motion.

Mr. H. REGINALD SIBSON said he thought the proprietors all agreed that the extension that the business of the Company had shown by the increased revenue was extremely gratifying, particularly in view of the reduction in price to which the report referred. There were one or two items in the accounts upon which he should like to make comment, and perhaps offer a word of criticism. And he thought the Board would accept this in the kindly way in which it was meant. He noticed that the amount due to the Company, although somewhat less than it was last year, still represented something approaching 25 per cent. of the total amount of the gas-rental and the revenue received for residual products. He assumed that the method of collecting the accounts in Calcutta was the same as prevailed throughout India—that was, monthly collection; and, unless there was special reason for this large amount being outstanding, he ventured to suggest that it was rather excessive to allow something like three months' arrears to stand on the books. If monthly collections were the vogue, he ventured to suggest that they should be kept more up-to-date. While on the accounts, he noticed the Chairman had referred to further expenditure in connection with retort-charging machinery and regenerative settings. Could the Chairman indicate how large an expenditure approximately they might look forward to for this? They would then see how far the reserve fund was likely to be further depleted. He also suggested that the Board might consider the possibility of formulating the accounts upon a method that would enable the various items to be placed under distinctive heads in the manner prevalent in this country in connection with the statutory form of accounts. This was not an impossible matter, as had been found in other places. He had much pleasure in expressing his appreciation of the results of the year's working, and of the completion of contracts to ensure an even more satisfactory revenue account than was presented to the proprietors last year.

The CHAIRMAN said that he quite appreciated the fairness with which Mr. Sibson had put his questions. With regard to the arrears, the system of collection in vogue with the Company was monthly; but there was sometimes a difficulty in getting the amounts in. At times the Municipalities of Calcutta and Howrah were not in a position to be quite up-to-date. But the Board knew that they were good debtors; and they did not want to disturb the harmonious relations by putting too much pressure upon them. As to the private consumers, he quite agreed with what Mr. Sibson had indicated—that the longer they let them run, the more chance there was of making a bad debt. He could assure the proprietors that the eyes of the Board were not blind to this. As to the balance to be met in the current year on account of the retort-house and charging machinery, he believed, as nearly as he could estimate, it would be something over £5000. With regard to the giving of more detail in the accounts, he did not think he altogether agreed with Mr. Sibson. Of course, their accounts were not like the statutory accounts of the English companies, or of the London companies, whose accounts were prescribed by the Board of Trade. He (the Chairman)was under the impression that, having regard to their

being a company carrying on operations abroad, they entered a little more in detail in the accounts than most companies similarly circumstanced. He knew of companies who grouped the whole expenditure into one item. He did not, however, suggest doing this; he would not, in fact, like the system at all for the Oriental Gas Company. But the matter should have the best attention of the Board.

Replying to Mr. J. H. MACKAY, the CHAIRMAN stated that he had no doubt the Company's men who had been looking after the public lighting would be employed by the Corporation under the new contract.

The motion was unanimously carried.

Moved by the CHAIRMAN, and seconded by Mr. STANLEY H. JONES, a dividend of 8 per cent. was declared, free of income-tax, and less the 3½ per cent. interim dividend.

On the proposition of the CHAIRMAN, seconded by Mr. A. T. EASTMAN, the retiring Directors (Mr. Robert Miller and Mr. Stanley H. Jones) were unanimously re-elected.

The AUDITORS (Messrs. S. W. Savage and F. Seel) were also re-appointed.

The CHAIRMAN remarked that a few years ago the question of the increase of the Directors' fees was brought forward by one of the proprietors; but he had not given the requisite notice, and therefore the Chairman, of course, ruled the matter out of order. The Board were not then desirous of having the matter introduced again until the question of the new contract had been settled. The present amount of the Directors' remuneration was fixed 27 years ago—in 1884; and when the Articles of Association were revised and settled ten years ago, the Directors did not take any steps to have the amount increased. During the 27 years, the work and responsibility of the Directors had multiplied three or four fold. Considering the labourer was worthy of his hire, the Board thought they could now submit a resolution increasing their fees by the sum of £400 per annum, as from July 1 last.

Mr. LOUIS PENNY seconded the motion.

Mr. T. W. FORMAN and Mr. A. F. ESSE suggested the postponement of the matter until the results of the new contract and fresh business operations were seen.

This, however, was not the general view of the meeting; and the resolution was adopted.

Moved by Mr. SIBSON, and seconded by Mr. LOUIS PENNY, the Chairman and Directors, and the officers and staff at home and in Calcutta, were sincerely thanked for their services.

The CHAIRMAN, in his reply, referred to the anxious time the Board had had the past two years.

Mr. LUFF also made acknowledgment on behalf of himself and his colleagues at home and abroad.

The Directors of the Power Gas Corporation recommend the payment of a dividend of 4 per cent., less income-tax, on the ordinary shares, for the year ended Sept. 30.

METROPOLITAN WATER BOARD.

Coal Supply During Labour Disputes—Water Supply to Factories.

At the Meeting of the Metropolitan Water Board last Friday, the subject of the steps taken by the Board's officers to maintain a supply of coal to the pumping-stations during the strike in the summer was under consideration.

At the previous meeting of the Board, Mr. G. W. Lawrence put the following questions to the Chairman of the Works and Stores Committee (Mr. John Sheehan): "(1) Is it a fact that during the recent strike the Board applied to the Government for protection in respect of the sources from which the Board obtained coal for the pumping-stations? (2) Is it a fact that the Government, through a Minister, asked the Board to make an arrangement with the Strike Committee? (3) Is it a fact that one of the Board's officials did, after great difficulty, see the Strike Committee and arrange for a supply of coal to the pumping-stations; the carmen having permits signed 'Tillett'?" Replying to the questions, Mr. Sheehan said the answer to the first was in the affirmative and to the second in the negative. As to the third, arrangements were made between the Board's contractors and the Strike Committee; and he could not say whether the carts bore a permit signed "Tillett." He added that no officer of the Board saw the permit, so they could not say what name was attached to it.

Mr. Lawrence characterized the answer to the last question as not quite satisfactory, and later in the proceedings he moved: "That if during labour disputes the supply of coal or other commodities necessary for the due performance of the Board's duties to the community be endangered, the Board do apply to His Majesty's Government for protection for that supply, and do not in any way directly or indirectly negotiate with strike committees or with individual members of such strike committees." He said the whole of the miserable dispute in August had put the Board in a very disagreeable position. If a similar situation arose again, they would know on whom to put the responsibility for a water famine in London. Alderman Huggett seconded the motion. Mr. Burrell moved an amendment to the effect that, if the protection desired was not afforded, the Board should take such measures as they considered desirable to get the needed supplies. Mr. Tozer seconded the amendment. Mr. Tripp said the Board's officials did the best they could under the circumstances. The motion was not adopted.

The report of the Appeal and Assessment Committee contained explanatory references to a case in which the conduct of the Board had been the subject of some unfavourable comments by his Honour Judge Parry, at the Lambeth County Court, in a case in which they had declined to return money paid to them in error. The difficulty arose in a great measure as the result of changes being made in the departmental work of the Board; and the Committee expressed the opinion that the remarks of his Honour would not have been made had he been in possession of all the facts. Some observations were also made by

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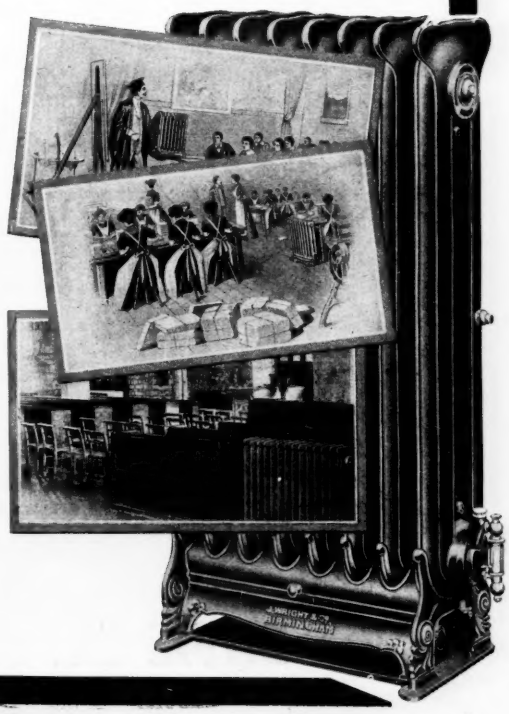

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284.

the Committee on the decision of the House of Lords in the Colley's Patents case, reported in the "JOURNAL" a fortnight ago (p. 545). The question turned on the charge for water supplied to a factory; and the Lord Chancellor decided that section 25 of the Board's Charges Act meant that the supply of water for closets and baths of the dimensions there mentioned must always be treated as a supply for "domestic purposes," as the Board had contended. The Chairman of the Committee (Mr. C. G. Musgrave), referring to the matter, said he hesitated to think what would have been the financial position of the Board if the case had been decided against them. The City of London, most of Westminster, and the sides of all the main arteries out of London would have been excluded from paying water-rates on rateable value. Mr. Tozer remarked that the loss to the Board would have been enormous. The position caused great anxiety, for it would have increased the huge deficit which was still staring the Board in the face.

GAS MANUFACTURE IN THE UNITED STATES.

Preliminary Report of the Census Bureau for 1909.

A preliminary statement of the general results of the thirteenth census of establishments engaged in the manufacture of illuminating and heating gas in the United States has lately been issued by the Director of the Census (Mr. Durand). It contains summaries which give the general figures for 1904 and 1909, and compares the different products by kind and quantity. The statistics do not include gas made in coke and other establishments producing gas as a bye-product, or producer and blast-furnace gas for power and furnace purposes made by establishments in which they were consumed. The figures are subject to such revision as may be necessary after a further examination of the original reports.

The general summary shows increases in all the items of the census of 1909, as compared with that for 1904, except for miscellaneous expenses, which decreased 6 per cent. The number of establishments increased 27 per cent.; capital invested, 26 per cent.; gross value of products, 33 per cent.; cost of materials, 41 per cent.; value added by manufacture, 30 per cent.; average number of wage-earners employed during the year, 22 per cent.; amount paid for wages, 23 per cent.; number of salaried officials and clerks, 44 per cent.; amount paid in salaries, 46 per cent.; primary horse power, 76 per cent. There were 1296 manufacturing establishments in 1909, and 1019 in 1904—an increase of 27 per cent. The capital invested, as reported in 1909, was $915,537,000—a gain of $190,502,000, or 26 per cent., over $725,035,000 in 1904. The average capital per establishment was approximately $706,000 in 1909 and $712,000 in 1904.

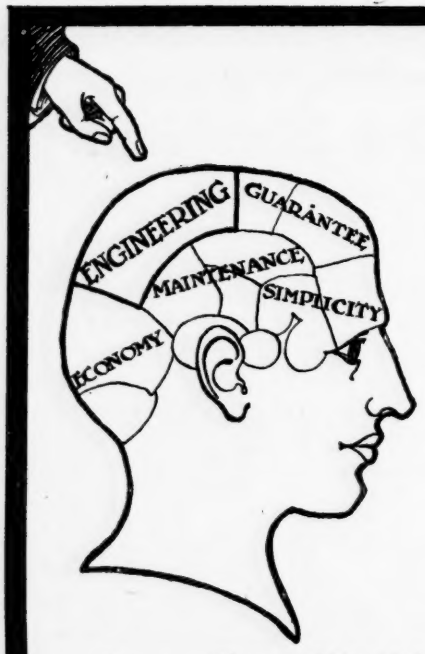
The value of products was $165,814,000 in 1909 and $125,145,000 in 1904—an increase of $41,669,000, or 33 per cent. The average per establishment was $128,000 in 1909 and $123,000 in 1904.

The materials used cost $52,428,000 in 1909, against $37,180,000 in 1904—an increase of $15,248,000, or 41 per cent. In addition to the component materials which enter into the products of the establishment for the census year, there are included fuel, rent of power and heat, and mill supplies. The value added by manufacture was in 1909 $114,386,000, and $87,965,000 in 1904—an increase of $26,421,000, or 30 per cent. This item formed 69 per cent. of the total value of the products in 1909 and 70 per cent. in 1904. The value added by manufacture represents the difference between the cost of materials used and the value of the products after the manufacturing processes have been expended upon them. It is the best measure of the relative importance of industries. The miscellaneous expenses amounted to $27,757,000 in 1909 and $29,557,000 in 1904—a decrease of $1,800,000, or 6 per cent. Miscellaneous expenses include rent of factory or works, taxes, and the amount paid for contract work, as well as such office and other expenses as cannot be elsewhere classified.

The salaries and wages amounted to $33,316,000 in 1909 and to $25,522,000 in 1904; being an increase of $7,794,000, or 31 per cent. The number of salaried officials and clerks was 13,515 in 1909 and 9406 in 1904—an increase of 44 per cent.; their salaries increased from $8,464,000 to $12,385,000, or 46 per cent. The average number of wage-earners employed during the year was 37,215 in 1909 and 30,566 in 1904—an increase of 6649, or 22 per cent.; their wages increased from $17,058,000 to $20,931,000, or 23 per cent. The primary horse power was 128,350 in 1909 and 73,101 in 1904, or 76 per cent. more. The average horse power per establishment was approximately 99 H.P. in 1909 and 72 H.P. in 1904.

The number of thousand cubic feet of gas produced was 150,835,793 in 1909 and 112,549,979 in 1904; being an increase of 34 per cent. Carburetted water gas was the kind most largely manufactured; the quantity going up from 54,687,418,000 feet in 1904 to 79,418,486,000 feet in 1909—a gain of 45 per cent. In 1909, it constituted 53 per cent. of all kinds; in 1904, 49 per cent. Mixed coal and water gas was next in importance, with 40,775,283,000 cubic feet in 1909 and 40,980,414,000 cubic feet in 1904—a decrease of 1 per cent. Straight coal gas increased from 12,693,034,000 cubic feet in 1904 to 19,985,253,000 cubic feet in 1909—a gain of 57 per cent. The greatest percentage of increase in specified gases is shown for acetylene, oil, and straight water gas, in the order named, though the quantities of each of these kinds are comparatively small. Acetylene gas increased from 7,880,000 cubic feet in 1904 to 25,186,000 cubic feet in 1909—220 per cent. more; oil gas, from 3,441,352,000 cubic feet in 1904 to 8,688,860,000 cubic feet in 1909, or 152 per cent.; and straight water gas from 715,550,000 cubic feet in 1904 to 1,726,082,000 feet in 1909, or 141 per cent.

There was a decrease in the production of coke for sale, from 89,186,434 bushels in 1904 to 82,049,683 bushels in 1909, or 8 per cent.; but the production of tar increased from 67,515,421 gallons in 1904 to 92,152,938 gallons in 1909, or 36 per cent. The figures do not include the gas and tar made in retort or bye-product coke-ovens. Four establishments engaged primarily in the manufacture of other products made gas, coke, and tar as bye-products in 1909. If these are added,



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the figures for straight coal gas become 20,012,811,000 cubic feet, and for acetylene gas 38,256,000 cubic feet; for coke, 82,094,030 bushels; and for tar, 92,191,308 gallons. The bye-products for 1904 are not available.

The following summaries give the general statistics for the industry, and the different products by kind and quantity, in the years 1909 and 1904 respectively.

General Summary.

—	1909.	1904.	Increase. Per Cent.
Number of establishments	1,296	1,019	27
Capital	$915,537,000	$725,035,000	26
Cost of materials used	52,428,000	37,180,000	41
Salaries and wages	33,316,000	25,522,000	31
Salaries	12,385,000	8,464,000	46
Wages	20,931,000	17,058,000	23
Miscellaneous expenses	27,757,000	29,557,000	Decrease 6
Value of products	166,814,000	125,145,000	33
Value added by manufacture (products less cost of materials)	114,386,000	87,965,000	30
Employees—			
Number of salaried officials and clerks	13,515	9,406	44
Average number of wage earners employed during the year	37,215	30,566	22
Primary horse power	128,350	73,101	76

Products by Kind and Quantity.

—	1909.	1904.	Increase. Per Cent.
Gas, thousands of cubic feet	*150,835,793	112,549,979	34
Straight coal gas	*19,985,253	12,693,034	57
Straight water gas	1,726,082	715,550	141
Carburetted water gas	79,418,486	54,687,418	45
Mixed coal and water gas	40,775,283	40,980,414	†1
Oil gas	8,688,860	3,441,352	152
Acetylene gas	*25,186	7,881	220
All other gases	216,643	24,330	790
Coke bushels	*82,049,683	89,146,434	†8
Tar. gallons	*92,152,938	67,515,421	36

*In addition, in 1909, 27,588,000 cubic feet of straight coal gas, 13,070,000 cubic feet of acetylene gas, 41,347 bushels of coke, and 38,370 gallons of tar were produced by establishments engaged primarily in the manufacture of other products.
† Decrease.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The Scottish Junior Gas Association—Western District—in their new policy of meeting half-an-hour earlier, got very creditably through the two items of business which they had before them this evening. When the Association was started, no one was more emphatic than Mr. Alex. Wilson, of Glasgow, in impressing upon members the desirability of giving contributions of a short nature, and, if possible, from their own experiences; and on this occasion we have his son giving an account of what is being done by means of electricity within the gasworks at Falkirk, where he is employed. Mr. Wilson's narrative of the use to which electricity is put was neither a distended nor a varnished one. It gave details as to the machinery employed, without which the communication would have been of little use to anybody inquiring after the sort of plant to procure; and it gave the costs of working in figures, which are more eloquent than words. The paper was very well received by the members. It was, in truth, an excellent beginning in the matter of preparing subjects for introduction to critical audiences. The address by Mr. W. B. M'Lusky, of Perth, upon the sale of gas, cannot be described otherwise than as a timely contribution of great weight upon a subject which is of paramount importance. It is characteristic of Mr. M'Lusky that he never offers an opinion, upon even the most trivial subject, without being able to give a reason for it. So that when he indicates a preference for the supplying of gas appliances free of rent, we may be sure that he first satisfied himself, in working, that this was the better way of doing business, and there need be no hesitation in following him. Whether followed or not, his dictum has always to be reckoned with by gas managers in shaping their policy with reference to trading in gas appliances.

At the monthly meeting of the Edinburgh and Leith Gas Commissioners on Monday—Lord Provost Sir W. S. Brown presiding—the Works Committee's minutes stated that: "On the motion of the Lord Provost of Edinburgh, seconded by the Provost of Leith, a remit was made to Mr. Herring, Consulting Engineer, Mr. Masterton, Acting Engineer, and Mr. Williams, Treasurer and Collector, having regard to the position of matters as disclosed in the Commissioners' accounts during the past few years; to consider and report separately and independently as to the falling off in consumption and revenue; and to offer suggestions by which an increased use of gas might be obtained, and how the financial position of the undertaking might be otherwise improved." The minute was adopted without comment. I wonder what the object is in asking for a separate and independent report from each of the three gentlemen named. Surely a joint report from them would be of more value than independent reports, which may advise different remedies to the Commissioners, who have not the technical knowledge that would enable them to discriminate, on the merits, between one scheme and another. Mr. Inches was then appointed

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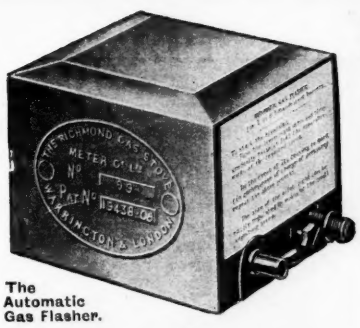

The Automatic Gas Flasher.

Showing Automatic Gas Flasher fixed to a Richmond "A.B.C." Gasfire. Any suitable wording can be supplied.

Convener of the Works Committee, and Bailie Lindsay, of Leith, Convener of the Finance and Law Committee.

On Tuesday evening, Mr. S. Milne was installed as President of the Aberdeen Association of Civil Engineers. Having delivered his Presidential Address, Mr. Milne read a paper on "The Production and Enrichment of Water Gas." He described the plant used in the Aberdeen Gas-Works for the manufacture of carburetted water gas. There were two sets of plant, each capable of producing 750,000 cubic feet of gas per 24 hours. The working of the plant was illustrated by lantern slides. Mr. Milne was thanked very heartily for his address.

On Wednesday afternoon, the gas was turned on to a portion of the extended area of supply which is being taken in by the Corporation of Denny. The extended scheme includes Dennyloanhead, Longcroft, Haggs, Hollandbush, and Banknock; the extreme point being rather more than four miles away from the gas-works. The extension so far as accomplished takes in the Dennyloanhead and Banknock districts. The gas was turned on by Bailie Lockhead, the Convener of the Gas Committee, who stated that the gas was being delivered at a pressure of 5 lbs. at the governor-house in Dennyloanhead, and was there reduced to ½ lb. After the ceremony, luncheon was served in the Railway Hotel. Bailie Lockhead was presented by the Engineers and Contractors with a silver rose-bowl. Ex-Provost Hunter, in proposing the toast of "The Town Council," stated that it was a gas question that brought the burgh into existence 34 years ago. It was found to be impossible to impose a voluntary assessment for lighting the place, and therefore a movement was commenced for the formation of a burgh. The whole aspect of the place had been changed on account of the work of the Council. He was told when they started this gas extension that they were sure to get 150 new consumers. They had actually already got 500.

It is intimated that at a meeting of the Gas Committee of the Perth Town Council this week tenders for new electric stoking machinery were under consideration, and that it was resolved to recommend the Council to accept offers amounting to £3689. It was stated that £240 would be required as half the cost of an electric cable from the electricity works to the gas-works.

It is a feature of socialistic propaganda that the promoters of it are never content to give assertion to their own views regarding the holding or the distribution of property, but always set themselves to nose out fancied enormities in property administration, by the laying bare of which they trust to get sympathetic hearing and support. This is what took place the other evening in Dumfries, where a public meeting convened by the Socialist party, "to discuss certain grievances borne by the poorer section of the ratepayers," was addressed by Mr. W. Gray. The very first of these so-called grievances unearthed by Mr. Gray was the charge for prepayment gas-meters, regarding which he declared that the poor people in the town were robbed every year to the tune of £450, or £5000 in ten years—a sum which would be sufficient to build a good few workmen's dwellings. A number of other subjects were dangled before the audience; but the gas-meter one was the only one which was, so to speak, brought home to them. In connection with it, a resolution was moved "protesting emphatically against the gross injustice perpetrated upon the consumers of gas through automatic meters, whereby they are literally robbed of 6d. per 1000 cubic feet of gas consumed," and also calling upon the Town Council to adopt the Housing (Scotland) Act, 1900. The resolution was carried.

On several occasions recently, notice has been taken of the efforts of Mr. J. Gordon to expose irregularities which have been discovered in connection with the administration of the Peterhead Corporation gas undertaking. The Town Council, while admitting the irregularities, are disposed to overlook them. Not so Mr. Gordon, whose desire it is to first make the public fully aware of all that has transpired in the investigation of the subject. On Monday evening a meeting of citizens was held in the Music Hall Buildings, the object of which was to appoint a Ratepayers' Vigilance Committee and to nominate candidates for the Town Council election, which takes place on the 11th inst. A Committee of fifteen was appointed, and instructions were given to support Mr. Gordon in his action to the gas undertaking.

It is regarded as a good augury for the advance of any subject that the public should begin to take notice of it, even though their notice be not altogether what might be regarded as favourable. Last Saturday there was a letter in the "Glasgow Herald," in which the writer stated that he had been considering the advisability of introducing gas-fires into his rooms, but was led to believe that they were detrimental to French-polished surfaces. As it was a most important question to householders, he would be pleased to hear if any of the readers of the "Herald" knew whether or not it was the case. On Tuesday, there was a reply, in which it was stated that there was no foundation for the statement. For six years gas-fires had been used regularly in the house of the writer, both in public rooms and bedrooms, without the slightest indication of such an effect.

The formal opening took place on Tuesday of the new water-works which have been constructed in extension of the works that have supplied Innellan with water for nearly forty years. The water was turned on by Mrs. Lamont, wife of Mr. Duncan Lamont, the Convener of the Water and Drainage Committee of the Cowal District Committee. Mr. Lamont stated that it was a gratifying fact that they had been able to complete the work without adding to the burden of the rates. Innellan could justly lay claim to a water supply which was the finest and purest in the West of Scotland, and to a gas supply which was perfection, thanks to the Dunoon Town Council.

It has been frequently mentioned that the embankment of the Earls Burn reservoir, constructed some years ago for the Falkirk and District Water Trust, was not water-tight. There was, in consequence of this state of matters, naturally a great deal of anxiety on the part of the Water Trustees, who have during the past few years been endeavouring to discover and remove the source of leakage. In the course of last summer, it was found that when the water in the reservoir rose to a certain height it overflowed a ridge of rock inside the reservoir, and escaped past the end of the puddle wall in the embankment. This has

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HIGH EFFICIENCY.

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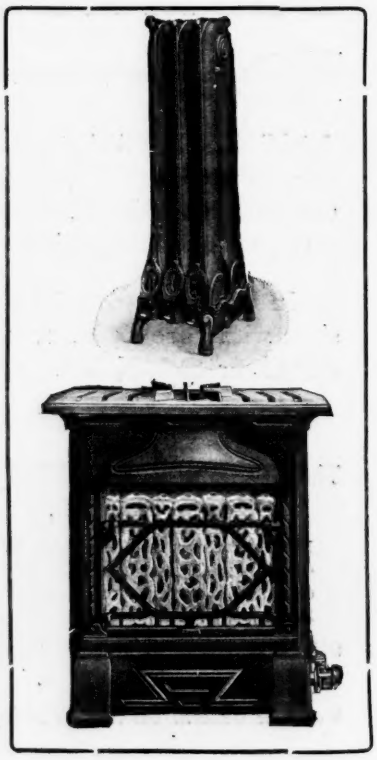
WARRINGTON, MANCHESTER, LONDON, & BRUSSELS.



now been remedied; and at a special meeting of the Water Trust, on Monday, a joint report by Mr. James Watson, of Bradford, and Mr. John D. Parker, of Glasgow, was read, in which it was stated that, in their opinion, the work was now throughout in a sound, suitable, and practically in a water-tight condition.

CURRENT SALES OF GAS PRODUCTS.

[For Table of "Tar Products Prices," see p. 713.]

LIVERPOOL, *Dec.* 2.

Sulphate of Ammonia.

All immediate requirements having apparently been covered, there has been less keenness in the demand this week, and consequently prices have shown a disposition to give way slightly. There has, however, been no decided reaction, and, although second-hand business has been recorded at rather less money, the nearest closing values are £14 2s. 6d. per ton f.o.b. Hull, £14 3s. 9d. per ton f.o.b. Liverpool, and £14 6s. 3d. per ton f.o.b. Leith. Manufacturers maintain a very firm attitude for future delivery, and refuse to make sales over the early months of next year below £14 7s. 6d. per ton f.o.b. at the principal ports. No new first-hand sales have transpired, but it is reported that dealers have taken orders abroad for January-April shipment at practically the equivalent of prompt quotations.

Nitrate of Soda.

The tone of this market continues quite firm, and the spot values remain unchanged at 10s. 1½d. per cwt. for ordinary and 10s. 4½d. for refined quality.

LONDON, *Dec.* 4.

Tar Products.

The markets for tar products remain firm. Pitch shows signs of improvement; but buyers appear to be still holding off the market on account of the high prices. Benzols are strong for near delivery. There are indications of improvement in solvent and heavy naphthas, and enhanced prices are asked in nearly all quarters. Crude carbolic acid is exceedingly firm, and good prices are being paid, provided prompt delivery can be given. Creosote remains very strong for both prompt and forward delivery.

The average values during the week were: Tar, 22s. 3d. to 26s. 3d. *ex* works. Pitch, London, 41s. to 41s. 6d.; east coast, 40s. 6d. to 41s.; west coast, Clyde 39s. 6d. to 40s., Manchester 39s. to 39s. 6d., Liverpool 39s. 6d. to 40s. Benzol, 90 per cent., naked, London 10d. to 10¼d. f.o.b.; North, 9⅛d. f.o.b.; 50-90 per cent., naked, London, 8d. to 8⅛d.; North, 8d. to 8⅛d. f.o.b. Toluol, naked, London, 9d. to 9⅛d.; North, 8⅛d. to 9d. Crude naphtha, in bulk, London, 4⅛d. to 4⅜d.; North, 3¾d. to 4d. Solvent naphtha, naked, London, 10d. to 10¼d. f.o.b.; North, 9¼d. to 9¾d. f.o.b. Heavy naphtha, naked, London, 11½d. to 1s. f.o.b.; North, 10d. to 10¼d. f.o.b. Creosote, in bulk, London, 2⅞d. to 3d.; North, 2⅜d. to 2½d., salty; 2⅝d. to 2¾d., liquid. Heavy oils, in bulk, 3d. to 3¼d. Carbolic acid, casks included, 60 per cent., east coast, 2s. 3d. to 2s. 4d.; west coast, 2s. 3d. Naphthalene, £4 10s. to £9; salts, 40s. to 45s., bags included. Anthracene, "A" quality, 1⅛d. to 1¼d. per unit, packages included and delivered.

Sulphate of Ammonia.

There has been a dull tone in the market during the past week, and very little buying has been done. Several parcels have been offered at reasonable figures, no doubt on account of forced sales. Actual Beckton is £13 17s. 6d.; outside London makes, £13 10s.; Hull, £14 3s. 9d.; Liverpool, £14 5s.; Leith, £14 7s. 6d.; Middlesbrough, £14 3s. 9d.

COAL TRADE REPORTS.

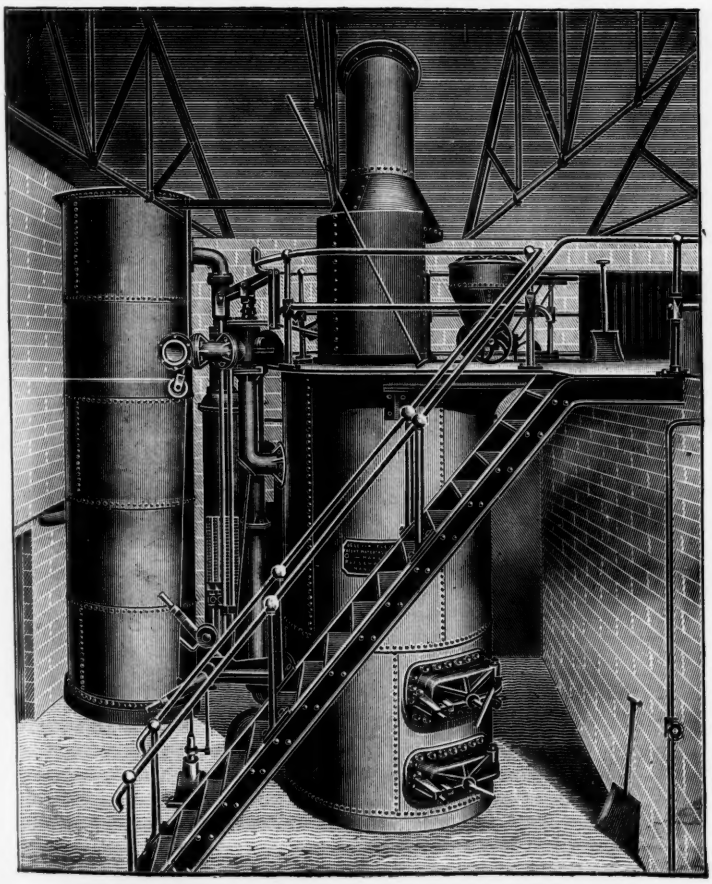
Northern Coal Trade.

The coal trade is brisk, and there are heavy exports, except when climatic influences delay the arrival of steamers. In steam coals, best Northumbrians are now scarce for the rest of this month, and the prices are very firm in consequence—at about 12s. to 12s. 4d. per ton f.o.b. Second-class steams are from 10s. 6d. to 10s. 9d. per ton; and steam smalls are from 5s. to 6s. 3d. The collieries are working well, and the production seems to be rapidly taken up. Gas coal is now at the period of the fullest demand; and as there is little free for prompt sale, the prices are firm, and higher where there is any quantity for early delivery. Durham gas coals are quoted from 11s. 9d. to 11s. 10½d. per ton f.o.b. for best kinds; and second-class gas coals are also higher at 10s. 6d. to 11s. per ton. "Wear specials" are scarce for prompt delivery, and are about 12s. per ton f.o.b. Some sales of gas coals are reported to Italian ports at higher figures. Contracts at present are not, however, numerous for gas coals—interest centring in other kinds, sales of which are being negotiated at advanced prices; but for gas coals there is a strong desire to stock coal that is contracted for so as to meet the heavy demand later in the month. Coke is firmer. Good gas coke, though in full supply, is quoted from 14s. 6d. to 15s. per ton f.o.b. in the Tyne or Wear.

Scotch Coal Trade.

There is no falling off in the demand, which, for all classes, continues to be very strong. Prices have accordingly advanced, and are now quoted at: Ell, 11s. 6d. to 12s. 3d. per ton f.o.b. Glasgow; splint, 12s. to 12s. 3d.; steam, 10s. 9d. to 11s. The shipments for the week amounted to 345,625 tons—an increase upon the previous week of 10,286 tons, and upon the corresponding week of 36,795 tons. For the year to date, the total shipments have been 14,993,284 tons—an increase of 328,727 tons.

DELLWIK WATER GAS PLANT



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Growth of Gas Consumption at Newtownards.

The Gas Committee of the Newtownards Urban District Council decided last Thursday to invite tenders for a new gasholder according to their Engineer's specifications. Last year an increase of 4 million cubic feet took place on the output. This year there is every indication of an increase of 5 millions, and a prospect of 4 to 5 millions additional increase next year—making in all about 13 millions in three years, or as much as the annual output of eleven years ago. The Gas Manager (Mr. Roberts) estimates that next year's output will be in all 46 million cubic feet. The question of supplying high-pressure gas to all the factories in the town has been under consideration. It may be mentioned that at present high-pressure distribution only extends to certain parts of the town. To meet the request of the owners of factories who are not in the vicinity of the high-pressure mains, the Committee have decided to erect small compressing plants suitable for the purpose, provided they supply power themselves, and pay the slightly increased price charged for this gas. The question of installing vertical retorts has been left over till further particulars may be obtained. In connection with this growth of business, it may be pointed out that there has been little or no increase in the population in the last twenty years.

Street-Box Explosion at Derby.—An alarming explosion of gas, happily unattended with serious result, occurred in Park Street, Derby, on the afternoon of Sunday, the 26th ult. Information having been conveyed to the police, a constable found the cover of a manhole lying on the pavement, and two others disturbed, while the sign of a public-house was badly damaged. The explosion is thought to have been due to an electric wire firing escaped gas in the manholes.

Sale of Stocks and Shares.—At the Mart, Tokenhouse Yard, E.C., last Tuesday, Messrs. A. & W. Richards offered for sale, by order of Directors, new issues of capital in the Aldershot and Hythe Gas Companies. The first lots consisted of an issue of such an amount of 4 per cent. perpetual debenture stock as would, including premiums, realize a net sum of £1994 16s. 8d. Altogether, £2078 of stock was sold, at £96 per £100. An issue of 6 per cent. non-cumulative preference shares of £10 each in the Hythe and Sandgate Gas Company was placed at par. On the same occasion, Messrs. Richards sold, by order of Trustees, some fully-paid £10 original shares (10 per cent.) in the Southend Water Company, carrying 4½ per cent. dividend, at £11 each; some new ordinary (7 per cent.) shares, of like nominal value, and carrying the same dividend, fetching £10 10s. apiece. A few £5 additional shares in the Herne Bay Gas Company, ranking for a maximum dividend of 7 per cent., which rate has been paid for some time, were sold for £7 each; and some £10 fully-paid "B" shares (8 per cent.) in the Tendring Hundred Water Company, carrying 4½ per cent. dividends, fetched from £11 to £11 5s. each.

The King and the Derwent Valley Water Scheme.—In the "JOURNAL" for the 7th ult. (p. 409), it was mentioned that the formal opening of the Derwent Valley Water-Works would probably take place next July, and that efforts were being made to get the King to perform the inaugural ceremony. His Majesty has asked the Board to repeat their invitation on his return from India.

Birmingham Gas-Works Extensions.—At the meeting of the Birmingham City Council last Tuesday, the projects to be embodied in the Bill for next session, of which notice has been given, were under discussion. With reference to the proposed extension of the gas-works, Mr. Harrison Barrow further asked the Council's approval to the inclusion in the draft of a clause authorizing the acquisition and use of land on the Birches Green Estate for gas-works and electric supply purposes. Mr. Bailey Cox and Mr. Simpson, as residents in Washwood Heath district, opposed the erection of further gas-works there; but, in reply, Alderman Sir Hallewell Rogers pointed out that the increase in output had been so great in recent years that the Gas Department were bound to look ahead. The site chosen was ideal for the purposes of gas-works, for there was a high railway embankment on one side, the sewage farm on another, and the destructor on another. The clause was agreed to.

APPLICATIONS FOR LETTERS PATENT.

25,815.—DOWLAND, R. W., "Gas-stove utensils." Nov. 20.
25,818.—CROSS, W., AND SON, LTD., and KIRBY, J. I., "Gas-heated box-irons." Nov. 20.
25,855.—CORTHÉSY, J. H. & J. H., JUN., and DICKSON, W. K. L., "Steam and gas condensers." Nov. 20.
25,873.—FERGUSON, F. H., "Inverted lamps." Nov. 20.
25,874.—CARPENTER, C. C., "Inverted burners." Nov. 20.
25,998-9-26,000.—SCHMIDT, G. F., "Gas-generator." Nov. 21.
26,003.—FOERSTER, M., "Bunsen tubes." Nov. 21.
26,048.—BOECKEM, F. W. O., "Gas-producing apparatus." Nov. 21.
26,069.—SMITH, J., "Anti-vibrator." Nov. 22.
26,237.—SHORT, F. A., "Measuring pressures." Nov. 23.
26,241.—CHINNERY, H. W., and HELBING, A., "Gas heating apparatus." Nov. 23.
26,251.—EDGAR, W., "Counting-mechanism of coin-freed apparatus." Nov. 23.
26,269.—PELSMAEKERS, A., "Combined gas and coal stove." Nov. 23.
26,336.—PARSONS, HON. R. C., and KENT, W. G., "Mixing liquids in definite proportions." Nov. 24.
26,388.—GRIMSHAW, J., "Incandescent burners." Nov. 25.
26,409.—COWAN, W., "Gas-meters" Nov. 25.
26,429.—ENGLAND, G. W., "Production of sulphate of ammonia." Nov. 25.

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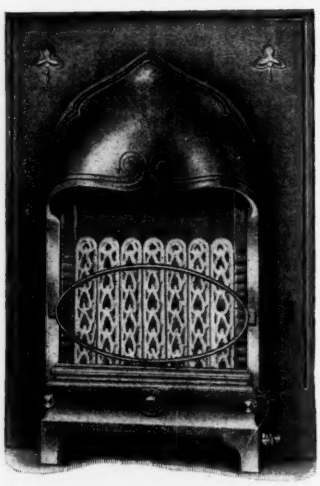

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BIRMINGHAM AND LONDON.

The Widemouth Water Supply Company has been registered with a capital of £2000, in £10 shares, for the purpose of supplying water in the district of Widemouth, near Bude, Cornwall.

Mr. W. H. Phillips, a member of the Manchester City Council, has given notice that he will at the next meeting of that body move a resolution to the effect that a Special Committee be appointed to consider the desirability of the Corporation undertaking the supply of coal to the ratepayers.

The Torquay Gas Company last week afforded their consumers an opportunity of witnessing demonstrations of the use of gas for paper-bag cookery, by Mrs. C. F. Pitcher, who gave ample proof that by this method meat, vegetables, and sweets can be better cooked, with less wastage and with the full retention of flavour. The demonstrations were well attended.

On the closing day of the Manchester Smoke Abatement Exhibition, a collection was made in aid of the sufferers by the recent explosion and fire at Messrs. Bibby's mills in Liverpool, and as a result Mr. James Kendall, the Hon. Secretary to the Manchester and Salford Smoke Abatement Society, has forwarded a cheque for £10 4s. 1d. to the Lord Mayor of Liverpool.

In the last number of the "JOURNAL," the registration of the Heathfield and Waldron Gas Company, Limited, with a capital of £5000, in £1 shares, was recorded. We learn that the object is to acquire the gas undertaking of the East Sussex Gas and Water Company, Limited, and supply gas in the above-named places. Among the first Directors is Mr. H. P. Maybury, the Kent County Engineer, who was formerly at Great Malvern.

Messrs. D. Hulett and Co., Limited, of 55, High Holborn, have been appointed agents for Reeves' patent slot grip bolt padlocks for slot-meter money boxes. An illustrated description of these padlocks has already appeared in the "JOURNAL."

A quick piece of work in connection with the extension of Messrs. R. & A. Main's fitting-shop and foundry at Edmonton has just been completed. Notwithstanding additions made to their shops during the past summer, it was found impossible to cope with the demand for the firm's "D.S.O." and "St. Nicholas" fires. Contracts were accordingly made six weeks ago for doubling the capacity of the foundry and fitting-shop; and this work was completed last week.

Mr. James Wilson (Messrs. Wilsons and Mathiesons, Limited, of Leeds) has recently been delivering lectures on the "Heating of Hot Water," with demonstrations, in connection with the North of England Association's Special Purposes Committee, at Newcastle, South Shields, Sunderland, and Stockton—the same lecture as that given at the Leith Walk Educational Schools, Edinburgh, and of which mention was made in a paragraph in last week's issue of the "JOURNAL" (p. 638).

According to a paragraph in yesterday's papers, a hitch has occurred in connection with the proposed combination in the Scottish tube trade. The negotiations—resulting in the signing of a preliminary agreement—were concluded some months ago, and the prospectus of the Scottish Tube Company, Limited, with a capital of £600,000, was to have been issued in October. Eight concerns were to be included in the combine, with which the largest makers of all—Stewarts and Lloyds', Limited—were also to work in harmony, nominating a Director.

TAR PRODUCTS PRICES.

Representative manufacturers give the following as fair current values for the week ending Dec. 2. Prices are net, and they include the usual packages and delivery f.o.b., f.a.s., or f.o.r., as customary.

Article.	Basis.	London.	North-East Coast.	East Coast, Yorks.	West Coast.		Glasgow.
					Liverpool.	Manchester.	
Tar, crude	per ton	—	20/9 26/3	22/- 26/-	—	21/- 25/-	—
Pitch	,,	42/6	40/6	40/6	40/-	39/3	40/-
Benzol, 90%	per gallon	1/2½	-/11½	-/11½	—	—	-/11½
Benzol, 50-90%	,,	—	-/11¼	-/10⅞	—	-/10⅞	—
Toluol, 90%	,,	1/1	-/11⅛	-/10⅞	—	-/10¼	-/11
Crude naphtha, 30%	,,	—	-/4⅝	-/4½	—	-/4	—
Light oil, 50%	,,	—	-/3½	-/3¾	-/3½	-/3¾	—
Solvent naphtha, 90-160	,,	—	-/10½	-/10	-/10	-/11	-/11⅛
Heavy naphtha, 90-190	,,	—	-/11⅜	-/11	-/11¼	-/11½	-/11½
Creosote in bulk	,,	-/3⅛	-/2½	-/2 7/16	—	-/2⅛	-/2⅛
Heavy oils	,,	—	-/2⅜	-/2⅝	-/2¾	-/2¾	-/2¾
Carbolic acid, 60's	,,	—	2/4½	2/7	—	—	2/5
Naphthalene, crude drained salts	per ton	—	44/6	42/6	47/6	47/6 50/-	—
,, pressed	,,	—	61/6	63/-	60/-	60/- 75/-	—
,, whizzed	,,	—	—	—	70/- 72/6	65/- 75/-	62/6
Anthracene	per unit	-/1⅞	-/1½	-/1½	-/1¼	-/1¼	—

GAS COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 671.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.	Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.	£			p.c.				£ s. d.
1,551,868	Stk.	Oct. 12	5	Alliance & Dublin Ord.	79—82	..	6 1 11	200,242	Stk.	Aug. 31	6	Lea Bridge Ord. 5 p.c. .	125—130	..	4 12 4
374,000	Stk.	July 14	4	Do. 4 p.c. Deb.	93—95	..	4 4 3	561,000	Stk.	Aug. 16	10	Liverpool United A. .	218—220	..	4 10 11
250,000	5	Sept. 28	7	Bombay, Ltd. . . .	6—6¼	..	5 7 8	718,100	,,	,,	7	Do. B. .	164—166	..	4 4 4
50,000	10	Aug. 31	15	Bourne-) 10 p.c. .	28½—29½	..	5 1 8	306,083	,,	June 30	4	Do. Deb. Stk.	102—104	..	3 16 11
311,810	10	,,	7	mouth Gas) B 7 p.c. .	16¼—16¾	..	4 3 7	75,000	5	June 15	6	Malta & Mediterranean	4⅞—5⅛	..	5 17 1
75,000	10	,,	6	and Water) Pref. 6 p.c.	14½—14¾	..	4 1 4	560,000	100	Oct. 2	5	Met. of) 5 p.c. Deb.	100—102	..	4 18 0
380,000	Stk.	Aug. 16	13	Brentford Consolidated	256—261	..	4 19 7	250,000	100	,,	4½	Melbourne) 4½ p.c. Deb.	100—102	..	4 8 3
330,000	,,	,,	10	Do. New . .	198—203	..	4 18 6	541,920	20	Nov. 10	3½	Monte Video, Ltd. . .	12—12½	..	5 12 0
50,000	,,	,,	5	Do. 5 p.c. Pref. .	120—122	..	4 2 0	1,775,892	Stk.	July 28	4½	Newc'tle&G'tesh'd Con.	101—102	..	4 5 9
206,250	,,	June 15	4	Do. 4 p.c. Deb. .	98—100	..	4 0 0	529,705	Stk.	June 30	3½	Do. 3½ p.c. Deb.	87—89	..	3 18 8
220,000	Stk.	Aug. 31	11	Brighton & Hove Orig.	217—222	..	4 19 1	55,940	10	Aug. 31	7/7/0	North Middlesex 7 p.c.	14½—15½	..	4 14 10
246,320	,,	,,	8	Do. A Ord. Stk. .	156—159	..	5 0 8	300,000	Stk.	Apl. 27	8	Oriental, Ltd. . . .	138—140	..	5 14 4
490,000	30	Sept. 28	12½	British	44½—45½	..	5 9 11	60,000	5	Sept. 28	8	Ottoman, Ltd. . . .	6⅞—7½	+¼	5 10 4
120,000	Stk.	June 30	4	Do. 4 p.c. Deb. Stk.	94—96	..	4 3 4	31,800	53	Aug. 16	13	Portsea Island A . . .	140—145	..	4 14 10
109,000	,,	Aug. 16	6	Bromley, A 5 p.c. . .	127—132	..	4 10 11	60,000	50	,,	13	Do. B . . .	133—138	..	4 14 2
165,700	,,	,,	4½	Do. B 3½ p.c. . .	97—102	..	4 8 3	100,000	50	,,	12	Do. C . . .	130—135	..	4 8 11
82,378	,,	,,	5½	Do. C 5 p.c. . .	117—122	..	4 10 2	398,490	5	Oct. 12	8	Primitiva Ord.	7⅞—7⅞	..	5 4 11
55,000	,,	June 30	3½	Do. 3½ p.c. Deb. .	82—84	..	4 3 4	796,980	5	June 30	5	Do. 5 p.c. Pref. .	5⅛—5⅜	..	4 13 0
250,000	Stk.	,,	4	Buenos Ayres 4 p.c. Deb.	95—97	..	4 2 6	488,900	100	Dec. 1	4	Do. 4 p.c. Deb. .	95—97*	..	4 2 6
100,000	10	—	—	Cape Town & Dis., Ltd.	2—3	..	—	312,650	Stk.	June 30	4	River Plate 4 p.c. Deb.	95—97	..	4 2 6
100,000	10	—	—	Do. 4½ p.c. Pref. .	4½—5½	..	—	250,000	5	Sept. 28	12	San Paulo, Ltd. . . .	10⅞—11	..	5 9 1
100,000	Stk.	June 30	4½	Do. 4½ p.c. Deb. Stk.	80—83	..	5 8 5	115,000	10	,,	6	Do. 6 p.c. Pref. .	11⅛—12	..	5 0 0
157,150	Stk.	Aug. 16	5	Chester 5 p.c. Ord. . .	111—113	..	4 8 6	125,000	50	July 1	5	Do. 5 p.c. Deb. .	50—51	..	4 18 0
1,513,280	Stk.	,,	5/9/4	Commercial 4 p.c. Stk.	110—112	..	4 17 7	135,000	Stk.	Aug. 31	10	Sheffield A	238—240	..	4 3 4
560,000	,,	,,	5⅛	Do. 3½ p.c. do. .	105—107	..	4 19 8	209,984	,,	,,	10	Do. B	238—240	..	4 3 4
475,000	,,	June 15	3	Do. 3 p.c. Deb. Stk.	76—78	..	3 16 11	523,500	,,	,,	10	Do. C	238—240	..	4 3 4
800,000	Stk.	May 31	4	Continental Union, Ltd.	88—93	−2	4 6 0	90,000	10	Sept. 28	6	South African . . .	8—9	..	6 13 4
200,000	,,	,,	7	Do. 7 p.c. Pref.	135—137	..	5 2 2	6,429,895	Stk.	Aug. 16	5/9/4	South Met., 4 p.c. Ord.	116—118	..	4 12 8
492,270	Stk.	—	5½	Derby Con. Stk. . . .	122—124	..	4 8 9	1,895,445	,,	July 14	3	Do. 3 p.c. Deb.	79—81	..	3 14 1
55,000	,,	—	4	Do. Deb. Stk. . . .	104—105	..	3 16 2	209,820	Stk.	Aug. 16	8½	South Shields Con. Stk.	155—157	..	5 8 3
840,150	10	July 28	10	European, Ltd. . . .	19½—20½	..	4 17 7	605,000	Stk.	,,	5⅜	S'th Suburb'n Ord. 5 p.c.	121—123	.	4 12 0
16,160,600	Stk.	Aug. 16	4/14/8	Gas-) 4 p.c. Ord. . .	104½—105½	..	4 9 11	60,000	,,	,,	5	Do. 5 p.c. Pref. .	117—120	..	4 3 4
2,600,000	,,	,,	3½	light) 3½ p.c. max. .	84½—86½	..	4 0 11	117,058	,,	July 14	5	Do. 5 p.c. Deb. Stk.	121—123	..	4 1 4
4,062,235	,,	,,	4	and) 4 p.c. Con. Pref.	102—104	..	3 16 11	502,310	Stk.	Nov. 10	5	Southampton Ord. . .	106—108	..	4 12 7
4,531,705	,,	June 15	3	Coke) 3 p.c. Con. Deb.	80—82	..	3 13 2	120,000	Stk.	Aug. 16	7⅛	Tottenham) A 5 p.c. .	145—148	..	4 16 3
258,740	Stk.	Sept. 14	5	Hastings & St. L. 3½ p.c.	94—96	..	5 4 2	483,940	,,	,,	5⅝	and) B 3½ p.c. .	115—117	..	4 16 1
32,500	,,	,,	6½	Do. do. 5 p.c.	—	..	—	149,470	,,	June 15	4	Edmonton) 4 p.c. Deb.	96—98	..	4 1 8
70,000	10	Oct. 12	11	Hongkong & China, Ltd.	17—17½	..	6 5 9	182,380	10	June 15	8	Tuscan, Ltd.	8⅜—9⅛	..	8 13 0
131,000	Stk.	Sept. 14	7½	Ilford A and C . . .	154—157	..	4 15 6	149,900	10	July 1	5	Do. 5 p.c. Deb. Red.	96—98	..	5 2 0
65,780	,,	,,	6	Do. B	125—128	..	4 13 9	236,476	Stk.	Aug. 16	5	Tynemouth, 5 p.c. max.	113—115	..	4 6 11
65,500	,,	June 30	4	Do. 4 p.c. Deb. . .	94—96	..	4 3 4	255,636	Stk.	Aug. 31	6⅞	Wands-) B 3½ p.c. . .	142—145	..	4 14 10
4,940,000	Stk.	Nov. 10	9	Imperial Continental .	184—186	+1	4 16 9	85,766	,,	June 30	3	worth) 3 p.c. Deb. Stk.	73—75	..	4 0 0
1,235,000	Stk.	Aug. 16	3½	Do. 3½ p.c. Deb. Red.	90—92	..	3 16 1								

Prices marked * are "Ex. div."

WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Appointments Vacant.

DRAUGHTSMAN. No. 5487.
DRAUGHTSMAN. Gibbons Brothers, Dudley.
RESEARCH CHEMIST (Temporary). No. 5488.
GAS-METER TESTER. Leicester Corporation. Applications by Dec. 14.
CANVASSER. No. 5486.
GAS-FIRE FITTERS. R. & A. Main, Limited, Edmonton.

Appointments Wanted.

CHEMICAL PLUMBER, &c. No. 5450.

Plant Wanted (New or Second Hand).

TEST GASHOLDERS. No. 5489.

Stocks and Shares.

AYLESBURY GAS COMPANY. By Auction. Dec. 12.
EASTBOURNE GAS COMPANY. By Auction. Dec. 12.
GRAYS AND TILBURY GAS COMPANY. By Auction. Dec. 12.
NORTH MIDDLESEX GAS COMPANY. By Auction. Dec. 12.
SHREWSBURY GASLIGHT COMPANY. By Tenders. Dec. 16.
SOUTH KENT WATER COMPANY. By Auction. Dec. 12.

TENDERS FOR

Coal.

SEATON BRICK AND TILE COMPANY.

Fire-Clay Goods.

NELSON GAS DEPARTMENT. Tenders by Dec. 15.
SALFORD GAS DEPARTMENT.

Gasholders (Test). No. 5489.

Gasholder and Tank.

ENNIS (Co. CLARE) GAS CONSUMERS' COMPANY. Tenders by Dec. 15.

Graphite. No. 5490.

Oxide of Iron.

BIRKENHEAD CORPORATION. Tenders by Dec. 14.

Tar for Roads.

COUNTY BOROUGH OF SOUTHAMPTON. Tenders by Dec. 18.

Tar.

BIRKENHEAD CORPORATION. Tenders by Dec. 14.
SHEPPY GAS COMPANY. Tenders by Dec. 13.

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